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ELECTRICAL ILLUMINATION IN MICROSCOPY: EXPERIMENTS AND VIEWS OF DRS. HENRI VAN HEURCK AND THEODOR STEIN.

BY E. A. SCHULTZE.

(*Read November 7th,* 1884.)

This subject has for some time had the attention of scientific men both in this country and in Europe. Among the first to note the advantages of the electric light in microscopical research, figures Dr. Henri Van Heurck, of Antwerp, a student who ranks as high in Belgium as does Mr. Edison in the United States. His investigation began, about ten years ago, with a trial of the effects of a Galvanic battery on platinum, but the trial yielded no satisfactory results. He was the first to employ the Swan lamp for microscopical illumination, the experiment being made at the Paris Exposition. Shortly afterward, in November, 1881, with a view to greater progress in this work, Mr. Swan endeavored to manufacture the smallest possible lamps; and in the following January he constructed one which required only seven volts, or the power of four Bunsen elements, and sent it to Dr. Van Heurck. The latter carefully tested its usefulness, and he published the results in the Proceedings of the Belgian Society of Microscopists. In March, 1882, a committee of that Society visited him for the purpose of witnessing his methods and measuring their success. Before the end of that year he published in the Bulletin of the Society an extended article on the adaptability of electrical illumination to the microscope, in which he gives a theoretical explanation of the superiority of the electric light over all others, and much useful information, besides, regarding its practical working. He found that for the resolution of diatoms, as well as for all other work requiring objectives of high power, the light furnished by his electric lamp,

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when fed by a suitable battery, was better by far than any he had previously employed ; also that an electro-motive force of six or seven volts amply suffices for all uses.

The views of Dr. Van Heurck are ably seconded by Dr. Theodor Stein, of Frankfort-on-the-Main, in an article contributed by him to the "Zeitschrift für Wissenschaftliche Mikroskopie," Vol. I., No. 2 (1884). I have made a digest of such parts as are material to my purpose, as follows.

'The electric light,' says Dr. Stein, 'has been in use many years for showing microscopic objects by projection upon a screen with the use of the magic lantern. With constant improvement in the manufacture of objectives, the discernment of fine structure was possible even by this method. But the excellence of the performance found its limit at a power of eighty diameters, a higher amplification seriously impairing definition.

'At the Electrical Exhibition in Munich, in 1882, trial was made of the advantage of electrical illumination in working with the compound microscope. The light furnished was found to be sufficient for the finest observation with objectives of the highest power, and to be free from the well-known disadvantages of other kinds of artificial light,—the yellow ray and the heat ray. All possible preparations were examined, such as muscle, nerve, epithelia, bone, skin, bacteria, diatoms, &c. Especially surprising was the faultless picture of the red blood-corpuscles, to the correct showing of which a yellow light is particularly inimical. In the region of blue and violet, the spectrum of the light from an incandescence lamp is incomparably more intense than that of light from any other artificial source. In these observations light of different intensities was used, ranging between sixteen and sixty candle-power, and was received by the substage mirror and was reflected thence upon the object.

'These experiments suggested to me, in the winter of 1882, the idea of setting aside the mirror, and placing the incandescence lamp beneath the stage for the direct illumination of the object. As no lamp small enough for the purpose was in existence, I requested Mr. C. H. F. Müller, of Hamburg, to make me some according to certain specifications which I gave him. At this time appeared in the Journal of the Royal Microscopical Society[1] an article by C. H. Stearn, who, at a meeting of the

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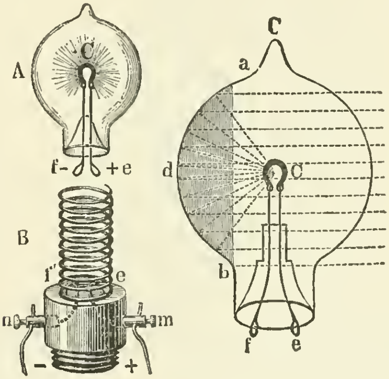
[1] Cf. Journ. R. Micros. Soc., Ser. II., Vol. III., 1883, Pt. 1, p. 29.

Society held January 10th, had exhibited a microscope furnished with electrical illumination. I again conferred with Mr. Müller; and I now have lamps, manufactured by him, which suit my purpose. Illustrated at *A*, Fig. 1, is a small lamp; at *C*, a larger one.[2] Each consists of a glass globe, at the exact centre of which is a horse-shoe carbon supported by two platinum wires. The wires terminate outside the globe, in the eyes *f* and *e*. The neck of the lamp *A* is forced into the spiral spring *B*, and connection is made with the hooks f^1 and e^1. The spring presses the lamp upward and thus brings about an intimate contact of the eyes *f* and *e* with the hooks f^1 and e^1. These hooks communicate with two conducting wires *m* and *n*, which are let into a hard-rubber screw. The screw itself is attached to the extremity of a jointed arm articulating with the microscope as shown in Fig. 2. To bring a lamp of the smaller size to a brilliant white heat, a current from two Bunsen or Grove elements 20 cm. high, is sufficient. The lamp *C*, Fig. 1, having a larger carbon, will require three elements. Should a stronger light in any direction be required, a part of the globe, as seen at *d*, Fig. 1, may be silvered on the outside so as to act as a reflector. For lamps to be used with low-power objectives, opal glass is preferable to common glass, as the light through it is less fatiguing to the eye.



1.

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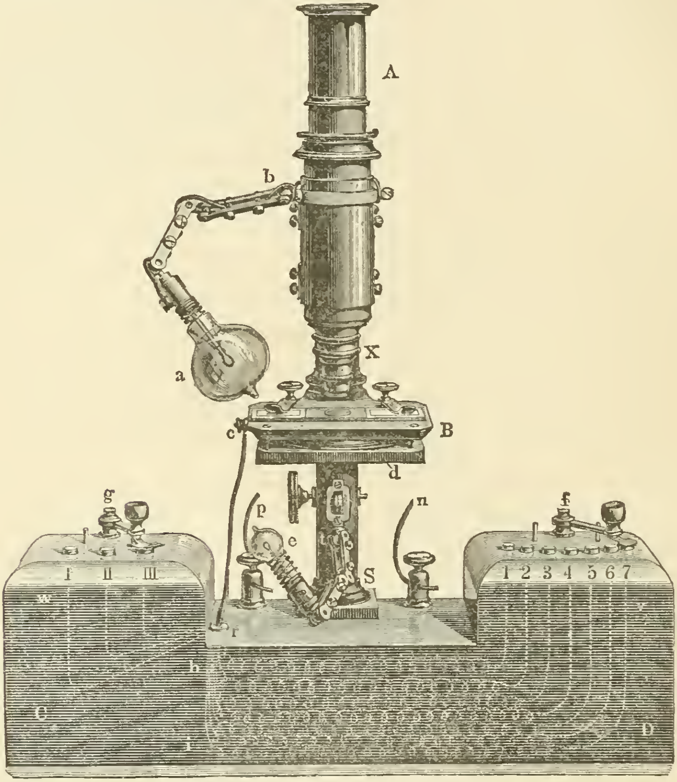
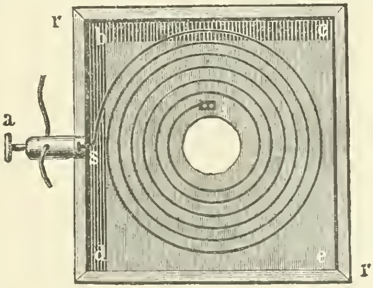
[2] All the cuts illustrating this article are copied from the "Zeitschrift für Wissenschaftliche Mikroskopie."

'In Fig. 2 we see a small lamp (*e*) and a larger lamp (*a*) attached to an upright microscope. The foot (*S*) of the instrument is screwed to a wooden box (*C D*). For facile movement in every direction, both lamps are supported by arms furnished with ball-and-socket joints.



2.

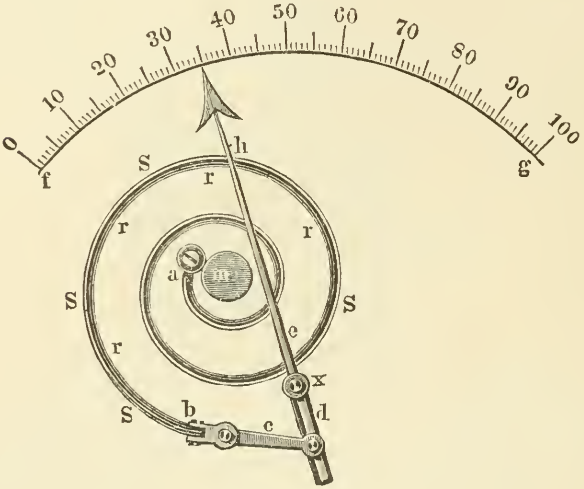
'The wires from the battery are fastened to the instrument by the binding-screws *p* and *n*. From the screw at *n* a concealed wire goes direct to the foot (*S*) of the stand, and beyond this point the microscope itself serves as a conductor communicating with the lamps *a* and *e*. The return wires are well insulated. That from the lamp *a* runs along the jointed arm *b*, then down the back of the stand and along the side of the stage to the support *c*, and thence into the box through the aperture *r*. That from the sub-stage lamp runs along the jointed arm *t*, then behind the stand and by the side of the stage to *c*, and thence it accompanies the first wire. Besides these there is a third wire, also insulated, and passing downward, which is attached to the stage. Between *c* and *r* the three are bound together in one bundle. The communication between the binding-screw at *p* and the lower end of one or other of the three wires entering the box at the orifice *r*, takes place through an important subsidiary apparatus, the rheostat, and is regulated by means of the switches *g* and *f*. The switch *f* and the spiral German-silver wires, *v i h*, constitute the rheostat, by means of which the electric current can be strengthened or weakened at pleasure. The wires have different diameters, and thus oppose to the current different degrees of resistance. If a small battery of two elements be used, the rheostat is superfluous. But if a powerful battery be employed, the current will, unless subdued, be too strong for the lamps and will destroy them.



3.

'The operator begins work by sliding the switch *g* to the proper point. He will move it to the knob I if he wish to use the upper lamp, to the knob II if the lower, and to the knob III if he desire the current to traverse the stage (*B*) alone. Next, to adjust the current to the size of the lamp, the power of the objective, and the character of the object under investigation, he will first place the switch *f* on knob 1, and then will cautiously slide it to knobs 2, 3, 4, etc., until the required degree of illumination is obtained.'

Dr. Stein next gives the construction of what he would call an "Electrically-heated Stage." Between the two plates of the stage is placed a platinum spiral (see Fig. 3), which may be heated by the electric current so as to raise the temperature of an object under examination. The degree of the heat is easily controlled by the rheostat, and it may be measured by means of a spiral bimetallic thermometer. In the illustration (see Fig. 4), *r* and *S* are ribbons of iron and brass, soldered together. The inner end, *a*, is screwed to the stage close to its opening, *m*. The free end, *b*, acts upon an index, *d*, which is pivoted at *x*, and whose point traverses the graduated arc *f g*.



4.

The rest of the article treats, in a full and interesting manner, of the application of electrical illumination to photomicrography, and describes a form of stand especially adapted to that department of microscopical work. The details cannot be given here. One or two facts, however, I must note,—the microscope has a vertical position instead of the usual horizontal one, and the illumination necessary for taking a most excellent photograph of *Pleurosigma augulatum* costs an electro-motive power of only five volts.

Dr. Stein concludes his article with an expression of confident belief that the microscopist who has once employed the electric light for his researches, will thenceforward use no other.

CRITICISMS ON J. KRUTTSCHNITT'S PAPERS[1] AND PREPARATIONS[2] RELATING TO POLLEN-TUBES.

BY N. L. BRITTON.

(*Read November 21st,* 1884.)

When a theory having no well-ascertained facts on which to base its arguments is persistently forced on the scientific community, it becomes the duty of some one to refute the ideas thus advanced and, if possible, prevent their further circulation, to the end that those who are less well-provided with opportunities for study may not be deceived into forming erroneous conclusions, or into doubting abundantly proved theories. As the Special Committee on Phanerogamic Botany for this Society, I have thought it my office to assume such task.

It has been sought by Mr. J. Kruttschnitt to show that during the process of fertilization of the ovules in Phanerogamic plants, the pollen-tubes which extend from pollen-grains resting on or attached to stigmatic surfaces, do not enter the ovules in the manner described in all recent treatises on Vegetable Physiology, but that the protoplasmic contents (fovillæ) of the grains reach the embryo-sac in some other way; and he suggests[3] that "the pollen-tubes discharge their contents amongst the papillæ of the stigma, * * * * thus carrying down the substance of the pollen only; * * * * the ovule is fertilized by absorbing the contents of the pollen-grain."

The mounts which Mr. Kruttschnitt has made and distributed consist of vertical and horizontal sections through ovaries, and longitudinal sections through stigmas and styles. This method of examination is not as satisfactory as that of picking the ovary open with a needle at the critical time. What is to be gained from horizontal ovarian sections is not apparent. The distribution of hundreds of such slides will have no effect on the opinion of the well-informed student. It is not stating the case too severely to say that his preparations indicate nothing whatever in proof of his theory; whatever evidence they bring is purely negative, and therefore unsatisfactory. His ideas are, indeed, but the revival of an ancient supposition ; and this fact suggests that a series of extracts from the works of investigators of acknowledged ability, which shall illustrate the growth of the accepted theory from its birth, will materially aid my effort to show that Mr. Kruttschnitt's position is untenable.

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[1] Am. Month. Micros. Journ., June, 1882; Sept., 1883.

[2] Am. Postal Micros. Club, special box No. 4, issued Oct. 16, 1884, and previously distributed slides.

[3] Am. Month. Micros. Journ., 1883, p. 166.

Until the observations of Amici (1823), pollen-tubes remained undiscovered, though the influence of pollen in seed production had long been recognized. "It was at first thought that the grains of pollen simply open on the stigma, and that the granules which they contain, being absorbed by the stigma, go to form the embryo, or concur in its formation."[4] Amici noticed the tubes proceeding from the pollen of *Portulaca oleracea*, and that they are formed by the protrusion of the intine through the extine.[5] A few years later Adolphe Brongniart examined the pollen of numerous species of plants and observed the tubes ; he succeeded in following them only into the style, where he believed they terminated and discharged their contents.[6] At about the same period, Amici and, independently, Ehrenberg, made observations indicating similar results. In 1831 Robert Brown presented to the Linnæan Society of London his memoir on "The Organs and Mode of Fecundation in the Orchideæ and Asclepiadeæ ;"[7] at that time he had traced the pollen-tubes to the placentæ, and possibly in one instance to the ovule.

In a subsequent communication to the Linnæan Society, "Additional Observations on the Mode of Fecundation in Orchideæ,"[8] speaking of pollen-tubes, he says :

"In *Orchis Morio* I have repeatedly and very clearly observed them scattered in every part of the surface of the placenta, and in not a few cases have been able to trace them into the aperture of the ovulum, to which they adhere with considerable firmness ;" and in a foot-note he adds, "Since these additional observations were read, I have found in several other Orchideæ, especially *Habenaria viridis* and *Ophrys apifera*, tubes scattered over the surface of the placenta, and not unfrequently inserted in like manner into the apertures of the ovula. * * * * At what period they reach the foramen of the testa, whether before or after the first faint appearance of the nucleus, I have not yet been able to determine."

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[4] Figuier, "The Vegetable World," p. 179.

[5] Atti della Societa Italiana, Vol. XIX., p. 254, and Ann. Sci. Nat., Vol. II., p. 66.

[6] Ann. Sci. Nat., Vol. XII., p. 34.

[7] Trans. Linn. Soc., Vol. XVI., pp. 685-745.

[8] Read June 5th, 1832 ; see "Miscellaneous Botanical Works of Robert Brown," published for the Ray Society, London, 1866, p. 540.

[Brown believed that the tubes proceeding from the pollen, which he calls *mucous cords*, do not themselves enter the ovules, but that they generate other tubes, the immediate agents of impregnation ; and he states that the latter are "remarkably and irregularly flexuose, apparently from the numerous obstacles they have to overcome after leaving the cords and beginning to mix with the ovula."]

In a still later paper, "Supplementary Observations," London, 1833,[9] he describes his further examination of *Asclepias purpurascens*. "On the 12th of the present month (July) I succeeded in tracing the pollen-tubes in that species not only over the whole ovuliferous surface of the placenta, but also going off to the ovula, to a definite point of each of which a single tube was found in many cases attached."

In 1835 Corda published his "Beiträge zur Lehre von der Befruchtung der Pflanze."[10] He was probably the first to announce the observation of the entrance of pollen-tubes into the micropyles of ovules in the Gymnospermæ, and he followed them to the embryo-sac in the Coniferæ. He says (I quote from Dr. Gray's translation), "By a careful examination of the cavity of the ovule in the fruit of *Pinus* with a lens, or even by a close inspection with the unassisted eye, grains of pollen may be seen reposing in its orifice. If we lay open the cavity in the scale by taking off the covering, removing at the same time the primine of the ovule which is originally adherent to the scale, we observe the pollen-tubes, which have reached from the pollen to the endostome of the secundine."

About the year 1837, Schleiden advanced the theory that the embryo is formed in the ovule at the time of impregnation by the contents of the extremity of the pollen-tube, and does not exist before the introduction of the tube. He says,[11] "At the flowering period, the pollen falls upon the stigma, and then commences the development of the reproductive cells. Each grain extends itself into a long filament, * * * * and in this form penetrates to the cavity of the germen, to enter one of the seed-buds (ovules) and, finally, into the embryo-sac. The extremity which has passed in, now becomes filled with cells, and these develop forthwith into a perfect, though as yet simple and minute plantule, the so-called embryo or germ." Schleiden figures the process in *Viola tricolor*. It is needless to say that this idea has long since been proved erroneous. At the present time all are agreed that the only office of the pollen-tube is to bring to the incipient embryo (archegonia, corpuscula) the substance of fertilization.

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[9] Loc. cit., pp. 549, 550.

[10] Acta Acad. Leopold Carol. Nat. Cur., Vol. XVII.; translated, and prefaced by remarks on the history of the subject, by Dr. Asa Gray, in Am. Journ. Sci., Vol. XXXI. (1st Series), p.308.

[11] "Die Pflanze" ; translated by Arthur Henfrey, under the title, "The Plant ; a Biography," London, 1848, p. 71, Pl. III. figs. 6–9.

Figuier remarks,[12] "This tube, as M. Brongniart has shown, elongates itself by a most remarkable vegetative process, insinuating itself into the interstices of the cellular tissue, which has been designated from this cause the conducting tissue, and that doubtless by which it is nourished. Occupying the centre of the style, this tube traverses its whole length, entering into the ovary, and is there brought in contact with the ovules, penetrating by their micropylic perforations." He gives figures of the ovules of *Polygonum* and *Viola tricolor* with the pollen-tubes attached, and other figures showing the results of Tulasne's observations which proved the falsity of Schleiden's theory of the origin of the embryo in the extremity of the pollen-tube.

Le Maout and Decaisne, in "Traité Général de Botanique," give the following account of the process of impregnation of the ovule, and illustrate it with a figure of *Œnothera longiflora*. I quote from Mrs. Hooker's English translation.[13] "Thereupon (after reaching the stigma), the pollen swells, through the action of endosmose, the inner membrane ruptures the outer at one of the points which touch the stigma; the pollen-tube lengthens, traverses the interstices of the stigmatic cells, and reaches the conducting tissue which fills the canal of the style, and which is charged, like the stigma, with a thick fluid. Still lengthening, the pollen-tube finally enters the cavity of the ovary, traverses the conducting tissue which lines the placentæ, and at last reaches the ovule, when it enters the micropyle and comes in contact with the cell of the nucleus (embryonic sac), its tip resting on the membrane of the sac, and partly adhering to it. Soon after this contact of the pollen-tube, one, or oftener two vesicles (embryonic vesicles) usually appear within the embryonic sac, below the tip of the pollen-tube. These vesicles elongate ; the upper and thinner end adhering to the membrane of the sac. While one of the two shrinks and disappears, the other develops, and fills more or less completely with its free end the cavity of the embryonic sac. * * * * All physiologists concur in the above."

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[12] "The Vegetable World," pp. 181 *et seq.*

[13] Pp. 156 and 157; fig. 750.

Le Maout and Decaisne describe also the fertilization of *Santalum*, and give illustrations of it.[14] "The fertilization of the ovule in Santalaceæ, presents a quite exceptional phenomenon, which deserves to be mentioned. The ovary is unilocular, and the free central placenta bears several suspended ovules ; each is a *naked* nucleus. At the period of fertilization the nucleus bursts at the lower part, the embryonic sac emerges by this opening and ascends along the whole length of the outer surface of the nucleus, to meet the pollen-tube a little below the top of the nucleus. The latter soon withers, and the embryonic sac, which alone grows, forms the integument of the seed."

H. Marshall Ward, in an elaborate paper "On the Embryo-sac and Development of *Gymnadenia conopsea*,"[15] says of its impregnation, "The pollen-tube, after a sinuous course from the placenta, has made a sharp bend ere plunging into the micropyle, and has then spread its broad apex over the 'Gehülfinnen,'[16] apparently penetrating between the sac and the integument ; but the difficulty of following so delicate an outline as it presents is no ordinary one. * * * * If no pollen-tube enters the micropyle, the whole ovule turns brown, shrivels, and the contents of the sac become ill-defined, and decay."

In Griffith and Henfrey's Micrographic Dictionary, last edition, there is a figure of the embryo-sac and supporting cells of *Orchis Morio*, after the contact of the pollen-tube. The two are shown in contact (pl. 47, fig. 5).

In Gymnosperms, after the pollen-tubes have extended for a short distance into the ovule, their growth temporarily ceases, or progresses very slowly ; they enter on a period of rest. "This continues in the annual-seeded Coniferæ a few weeks, in the biennial-seeded about a year. For example, the pollen-tubes reach the corpuscula of *Taxus baccata* at the end of May of the first year, of *Pinus sylvestris* at the beginning of June of the second year."[17]

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[14] Loc. cit., p. 157 ; figs. 751, 752, 753.
[15] Quart. Journ. Micros. Sci., Vol. XX. (New Series), p. 1, pls. I., II., III.
[16] Germinal vesicles. *Literally*, female consorts.

The length of the pollen-tube in angiospermous plants is dependent on the length of the style. The time required for the pollen-tubes to reach the ovules after starting from the grains, is, however, very different in different plants, and is in no way related to the stylar elongation. "In *Crocus vernus* the pollen-tube travels the distance (10 mm.) from the stigma to the micropyle in from one to three days, in *Arum maculatum* (2 to 3 mm.) in five days. The short style of many Orchids is penetrated by the pollen-tube only after the lapse of several weeks or months."[18] The same statement is made by Hofmeister.

Dr. Asa Gray states the known facts in the process of fertilization of the ovule, in the following language :—[19]

"In many kinds of pollen, the grains, when immersed in water, soon distend to bursting, discharging the contents. In others, and in most fresh pollen, when placed in ordinarily aerated water, at least when this is slightly thickened by syrup or the like, and submitted to a congenial temperature, a projection of the inner coat through the outer appears at some one point, and by a kind of germination grows into a slender tube, which may even attain two or three hundred times the diameter of the grain ; and the richer protoplasmic contents tend to accumulate at the farther and somewhat enlarging extremity of this pollen-tube. * * * * Commonly the pollen remains unaltered until it is placed upon the stigma. The more or less viscid moisture of this incites a similar growth, and also doubtless nourishes it ; and the protruding tube at once penetrates the stigma, and by gliding between its loose cells buries itself in the tissue of the style, descending thence to the interior of the ovary and at length to the ovules. Fertilization is accomplished by the action of this pollen-tube upon the ovule, and upon a special formation within it."

M. Detmer has examined the structures which facilitate the passage of the pollen-tube into the ovule, in a great many species of plants.[20] He states that in *Welwitschia* (a peculiar Gymnosperm from South Africa) the corpuscula develop into long tubes within the nucellus, meeting the pollen-tubes.

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[17] Detmer, "Lehrbuch der Pflanzenphysiologie," p. 354.

[18] Loc. cit., p. 358.

[19] "The Botanical Text Book," Part I., pp. 258–259, 1880.

[20] Jenaische Zeitschr. Naturwiss. XIV., 530 ; and Abstract in Journ. Roy. Micros. Soc., Series 2, Vol. I., p. 262. See also observations of M. G. Capus, in Ann. Sci. Nat (Bot.), VII., p. 209 ; and abstract in Journ. Roy. Micros. Soc., 1879, p. 910.

The editor of the "Journal of the Royal Microscopical Society" thus sums up the results of Detmer's observations : "The growing pollen-tubes receive their formative materials from the mucilaginous and amyloid substances secreted by secreting organs on the stigma, and in the stylar canal and interior of the ovary. These secreting organs are more or less papillose. * * * * Besides providing nutrition for the pollen-tubes, these papillose structures furnish also a conducting tissue to guide the pollen-tube * * * * to the micropyles of the ovules. * * * * Seeing that this tissue reaches up to the very micropyle itself, and that it only can supply the pollen-tube with the nutriment it requires, it follows that the entrance of the pollen-tube into the ovule is purely a mechanical phenomenon and does not depend on any mysterious relationships between the pollen-tube and the embryo-sac."

The most elaborate investigations on the whole subject of vegetable impregnation are those of E. Strasburger. Indeed, they are given in such minuteness of detail that I cannot hope in an article of this kind to present even an abstract of them ; and I will merely name, in a foot-note, some of the publications in which they are to be found.[21] An examination of the results reached by this distinguished physiologist cannot fail to convince the reader of the truth of the statement that pollen-tubes enter the ovules and deposit part of their contents.

Hofmeister also has contributed largely to the literature of these phenomena.

Bessey thus describes the impregnation of the ovule in Gymnospermæ,[22] and he illustrates it with diagrams of the fertilized ovule in *Pinus Larico* after Strasburger, and of *Juniperus communis* after Hofmeister :—

" Fertilization is effected by means of the pollen, which comes in contact with the apex of the ovule. * * * * When the ovule has reached the proper stage the micropyle is filled with a fluid, which, drying, carries the adherent pollen grains into contact with the apex of the ovule body, where they germinate and form pollen-tubes ; the latter penetrate the soft tissue of the ovule and eventually reach the corpuscula. * * * * The union of the protoplasm of the pollen-tube with that of the germ-cell appears to take place by diffusion through the wall of the former, as no openings in it have been discovered." He refers to the fecundation of Angiospermæ in the following language,[23] illustrating the process by a figure of the fertilized ovule of *Viola tricolor* taken from Sachs :—

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[21] "Ueber Zellbildung und Zelltheilung," Jena, 1875 ; "Die Befruchtung bei den Coniferen," Jena, 1872 ; "Ueber Befruchtung und Zelltheilung," Jena, 1877.

[22] "Botany for High Schools and Colleges," 1880, p. 403.

" Fertilization takes place as follows : The pollen grain, resting upon the moist surface of the stigma, absorbs moisture and germinates, sending out a tube which penetrates the soft tissues of the stigma and style, finally reaching the cavity of the ovary, where it enters the micropyle of an ovule."

Dr. William B. Carpenter's treatment of this subject is clear and concise. "The tracing downwards of the pollen-tubes through the tissue of the style may be accomplished by sections (which, however, will seldom follow one tube continuously for any great part of its length), or, in some instances, by careful dissection with needles. Plants of the *Orchis* tribe are the most favorable subjects for this kind of investigation ; which is best carried on by artificially applying the pollen to the stigma of several flowers, and then examining one or more of the styles daily. 'If the style of the flower of an *Epipactis* (says Schacht), to which the pollen has been applied about eight days previously, be examined in the manner above mentioned, the observer will be surprised at the extraordinary number of pollen-tubes, and he will easily be able to trace them in large strings, even as far as the ovules. *Viola tricolor* and *Ribes nigrum* and *rubrum* are also good plants for the purpose ; in the case of the former plant, withered flowers may be taken, and branched pollen-tubes will not unfrequently be met with.' The entrance of the pollen-tube into the micropyle may be most easily observed in Orchideous plants, and in *Euphrasia* ; it being only necessary to tear open with a needle the ovary of a flower which is just withering, and to detach from the placenta the ovules, almost every one of which will be found to have a pollen-tube sticking in its micropyle."[24]

The artificial branching of pollen-tubes has been well illustrated and described by S. Reisseck.[25]

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[23] Loc. cit., p. 422.
[24] "The Microscope and its Revelations," 6th Edition, 1881, pp. 464, 465.
[25] Acta Acad. Leopold Carol. Nat. Cur., XXI., Pt. 2, pls. XXXIV., XXXV.

Sachs describes the fertilization of the *Coniferæ* as follows, giving illustrations of *Taxus Canadensis* and *Juniperus communis*, both taken from Hofmeister :—[26]

"The pollen-grains having reached the apex of the nucellus put out their tubes at first only for a short distance into its tissue ; their growth is then for a time suspended. After the archegonia are completely developed, the pollen-tubes begin to grow again into the endosperm in order to reach them.[27] * * * * Whilst the pollen-tubes penetrate through the loose portion of the tissue of the nucellus, their width gradually increases at their lower end, their wall becoming at the same time thicker ; until at length they meet the wall of the embryo-sac which has now become soft, break through it, penetrate into the funnel of the endosperm, and attach themselves firmly to the cells of the neck of the archegonia."

The process in Angiospermæ is thus described, and a figure of the fertilized ovule of *Viola tricolor* given in explanation:—[28]

"The pollen-grains which germinate on the stigma send out their tubes through the channel of the style where there is one, or more usually through the loose conducting tissue in its interior, down to the cavity of the ovary. Frequently both in erect basilar and in pendulous anatropous ovules the micropyle lies so close to the base of the style that the descending pollen-tubes can enter it at once ; but more often the pollen-tubes have to undergo further growth after their entrance into the cavity of the ovary before they reach the micropyles of the ovules ; and they are then guided in the right direction by various contrivances.[29] * * * * Since every ovule requires one pollen-tube for its fertilization, the number of tubes which enter the ovary depends, speaking generally, on the number of ovules contained in it ; the number of pollen-tubes is, however, usually larger than that of the ovules ; where these latter are very numerous, the number of pollen-tubes is also very large, as in Orchideæ, where they may be detected in the ovary even by the naked eye as a shiny white silky bundle."

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[26] "Text Book of Botany," Edited by Sidney H. Vines, Oxford, 1882, pp. 523, 524.

[27] Compare Detmer, loc. cit. "In *Salisburia adiantifolia* (Ginkgo), fertilization does not take place till October, when the fruit is ripe and has already fallen off. The embryo is developed within the seed during the winter months" (See Strasburger "Die Coniferen und Gnetaceen," 1872, p. 291).

[28] Loc. cit., pp. 582, 583.

[29] Compare Detmer, "Jenaische Zeitschr. Naturwiss." XIV., p. 530.

The Botanical Atlas[30] contains a large colored drawing of the ovule of *Narcissus poeticus* undergoing fertilization. The process in *Viola tricolor* is also illustrated in the same publication.

In Wood's Class-book of Botany may be found a figure[31] illustrating the fertilization of *Polygonum Pennsylvanicum.*

In the light of the mass of evidence which we have brought forward in support of the accepted theory of fertilization (and it is by no means a complete index to the literature of the subject), any further remarks are almost superfluous. I will merely add that a few years ago I was fortunate enough to examine the ovary of *Cypripedium acaule* at a favorable time, and there observed the pollen-tubes filling the style like a skein of silk and many of them connected with the ovules. The observation was made in the field, by merely tearing open the ovary, and the specimen was inadvertently lost. But even if I had not had the aid of ocular evidence, I would hesitate to adopt a theory which, like that of Mr. Kruttschnitt, is a deduction from negative considerations alone. The fact of failure on the part of one, or, indeed, of several persons, to discover a pollen-tube in contact with the embryo-sac of an ovule, can, it seems to me, have no weight, when viewed in connection with the fact that so many able investigators have often and undeniably seen such contact.

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[30] By D. McAlpine, Pt. I., Phanerogamia, New York, 1883.

[31] Fig. 607.

PROCEEDINGS OF THE SOCIETY.

MEETING OF OCTOBER 3D, 1884.

The President, Mr. C. Van Brunt, in the chair.

Twenty-two persons present.

The Corresponding Secretary read two letters,—one from the Managers of the American Exhibition to be held at London next year, inviting the Society's coöperation ; the other from the Smithsonian Institution, asking for portraits of prominent scientific men.

The following objects were exhibited :—

Mineral Wool : by G. F. KUNZ.

Furnace Slag : by G. F. KUNZ.

Oxalurate of Ammonia (Arborescent Crystals) : by EDWARD G. DAY.

A Möller Slide illustrating thirty-six species of *Pleurosigma* : by W. G. DE WITT.

Pond-life, from Staten Island : by E. A. SCHULTZE.

Pond-life, from New Jersey : by A. D. BALEN.

1. *Melicerta ringens.*
2. *Plumatella repens.*

Mr. Balen said that he had expected to exhibit *Stephanoceros Eichornii.* He had a few days before collected some from a pond in which he had sought for it several years without success.

Mr. Day, who exhibited the slide of Arborescent Crystals of the Oxalurate of Ammonia, spoke of the uncertainties of success attending efforts to produce in all cases a definite form of crystal.

Mr. Day showed a hair-worm of a length of twenty-one and a half inches, which he had taken from a grasshopper that was not more than one and a half inches long.

Mr. E. B. Grove said that he had discovered in the large gray grasshopper the same parasite that Mr. Day had found, but of a less length in proportion to the size of the host.

Mr. Day stated that he had received from Mr. P. L. Hatch a letter informing him of his finding tape-worms in hen's eggs.

MEETING OF OCTOBER 17TH, 1884.

The President, Mr. C. Van Brunt, in the chair.

Thirty-seven persons present.

Mr. John A. Chambers was elected an Active Member of the Society.

Dr. Antonio de Gordon y Acosta, of the University of Havana, Cuba, was elected an Associate Member.

The following objects were exhibited :—

Frond of Fern, stained, showing Sporangia and Spores : by EDWARD G. DAY.

Group of Insect Eggs : by M. M. LEBRUN.

Elytron of *Carabus :* by E. A. SCHULTZE.

Elytron of *Necrophorus mortuorum :* by E. A. SCHULTZE.

Skin of Dogfish : by WALTER H. MEAD.

Crystallized Natrolite, from Weehawken Tunnel : by G. F. KUNZ.

Clathrocystis : by A. D. BALEN.

Organisms from Croton Water : by A. D. BALEN.

Multiple Images formed by the Eye of the Cockroach (*Blatta orientalis*) *:* by J. D. HYATT.

Dr. Britton called attention to Dr. Waller's Report to the City Board of Health, presented about five years ago, in which Croton-water organisms are described.

Mr. Hyatt stated that he had lately experimented with the eyes of a variety of insects with the view of ascertaining their comparative excellence for showing multiple images under the microscope, and that he had found the eyes of the mosquito and the cockroach to be the fittest for this purpose.

MEETING OF NOVEMBER 7TH, 1884.

The President, Mr. C. Van Brunt, in the chair.

Forty-five persons present.

Mr. Henry M. Dickinson was elected an Active Member of the Society.

The following objects were exhibited :—

Stellate Hairs on leaf of Mallow : by WALTER H. MEAD.

Eye of Insect, showing Hexagonal Form of Facets : by EDWARD G. DAY.

Section of Eye of *Limulus :* by J. D. HYATT.

Parasite found on a Mosquito : by J. D. HYATT.

Section of Spore Coal : by M. M. LE BRUN.

Pond-life : by A. D. BALEN.

1. *Volvox minor.*
2. *Actinosphærium Eichornii.*

Of Spore Coal, Dr. Britton said : "I have here specimens of Huron shale from Ohio, in which the bodies supposed to be spores from the Lycopods of that period are well shown. These bodies are small, black, globular, of uniform size, and without discernible structure ; and they occur in enormous quantity throughout the deposit. An interesting article on this subject, from the pen of Prof Orton, was published in the Proceedings of the Montreal meeting (1882) of the American Association for the Advancement of Science."

Mr. E. A. Schultze, in an article printed elsewhere in this Number of the JOURNAL, set before the Society the efforts which have been made in Europe to employ successfully the electric light in microscopical work. For researches requiring the use of high-power objectives, it had been found superior to all other kinds of artificial illumination. Dr. Theodor Stein had devised a rheostat which brings the electric current under easy and perfect control, thus securing safety to the lamp and constancy to the intensity of the light.

Dr. F. Y. Clark said: "In my experiments in the use of electrical illumination, I have found the chief obstacle to success to consist in the difficulty of getting a suitable battery. I have, however, finally procured one which works admirably. It is the Haid Electric Battery, a recent invention, and was made by the Excelsior Manufacturing Co., of this city. It has three elements, and it runs from one to three hours. It is portable—it can be carried in one's pocket, and it is easily managed. In my experience the electric light is far the best for the examination of objects, be they transparent or opaque ; and it does not weary my eyes."

Mr. P. H. Dudley : "I have tried to use the Galvanic current for illumination in photomicrography, but have found its action too inconstant. You may not always, by the eye, notice the fluctuations in the intensity of the light, but in photography you will remark them quickly. The light from a kerosene lamp works better."

The President: "I have found that an incandescence lamp, to work well, must have the carbon near the top of the globe; and that this part of the globe must be flat, so that it may be brought near to the object, and may not produce diffraction rings; and that the bottom should be non-reflecting, since reflected light, mingling with the direct rays, occasions indistinctness. White light is certainly better than yellow light; and I believe that if a good rheostat can be had, by which the strength of the current may be so regulated that the carbon can be brought to a white heat and kept there without endangering either the carbon or the globe, electrical illumination will come into use for microscopical purposes everywhere, particularly in delicate work. The rheostat made by Dr. Stein, which is described in Mr. Schultze's communication, seems complete."

MEETING OF NOVEMBER 21ST, 1884.

The President, Mr. C. Van Brunt, in the chair.

Seventy-five persons present.

Dr. N. L. Britton, as Committee on Phanerogamic Botany, brought forward the subject of the fertilization of the ovule. His views were in full accord with the current theory, which teaches that the elastic inner coat of the pollen-grain, extending itself in the form of a slender closed sac called the pollen-tube, and carrying within itself at its extremity the fovillæ of the pollen-grain, descends into the loose tissue of the stigma and the style, and thence into the interior of the ovary; and that this tube eventually enters the micropyle of an ovule, rests its point on the embryo-sac, and in some way not fully explained, communicates its contents to the germinal vesicle and fertilizes it. His object was to combat, in the interest of science, the views of Mr. J. Kruttschnitt, of New Orleans, who denies that the pollen-tube itself penetrates to the embryo-sac, and suggests that its contents are discharged among the tissues of the style and that they pass thence to the ovary and the ovules. Dr. Britton fortified his position by ample quotation from eminent authorities, and he illustrated his subject with drawings projected upon the screen by the magic lantern, and with a mounted section of *Monotropa uniflora* showing the pollen-tube in contact with the embryo-sac —a slide furnished for the occasion by Mr. Joseph Schrenk.[1]

The President approved Dr. Britton's criticisms, and invited discussion.

Mr. Schrenk said: "It has been stated by Strasburger that the protoplasm of the pollen-tube always occupies the end of the tube; and the truth of this statement is upheld by the longitudinal section of *Monotropa uniflora* which I have the pleasure of exhibiting under the microscope this evening. But, besides this feature, we can observe on this slide an interesting mechanical contrivance by which the contents of the pollen-tube are confined to the terminal part of the organ. Close behind the body of protoplasm a sort of partition, thick and shiny in appearance, is formed, and, as the growth of the pollen-tube advances, other partitions are built up. For this we can conceive no other function than to keep the protoplasm from travelling back. This peculiarity of structure certainly supports the theory that the protoplasma of the pollen advances within the pollen-tube itself and nowhere else."

Mr. J. D. Hyatt said: "Prof. Alphonso Wood told me in detail his researches in this department of vegetable physiology. The cut in his book, representing the pollen-tube of *Polygonum Pennsylvanicum*, to which Dr. Britton has alluded, was drawn from his own observation."

MEETING OF DECEMBER 5TH, 1884.

The President, Mr. C. Van Brunt, in the chair.

Forty-five persons present.

Mr. Charles F. Lemcke, Mr. Anthony Woodward, and Mr. M. H. Eisner were elected Active Members of the Society.

The following objects were exhibited :—

Pulex irritans, made transparent by hydrogen peroxide : by J. D. HYATT.

Pleurosigma angulatum, shown by the electric light : by G. S. WOOLMAN.

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[1] Dr. Britton's article is given elsewhere in this Number of the JOURNAL. See p. 7.

Parasite of *Chenalopex Ægypticus* (prepared by Prof. Simonson, of Zurich) : by E. A. SCHULTZE.

Heteromeyenia repens, showing the Statospheres : by A. D. BALEN.

Cocconeis on *Anacharis :* by A. D. BALEN.

Stentor cœruleus : by A. D. BALEN.

Aspergillus glaucus on Cheese : by B. BRAMAN.

HYDROGEN PEROXIDE AS A BLEACHING AGENT.

Mr. Hyatt said: "Knowing that hydrogen peroxide possesses the property of discharging the color from organic bodies without injuring their tissue, I determined to make trial of this agent in preparing insects for examination. The result is highly gratifying. The flea which is on the stage of one of the microscopes, was bleached in this way. The heart and all the other internal organs are clearly shown. Each is perfect, and each is in its proper place. The exhibition of the respiratory system is particularly fine. In the process of decoloration by liquor potassæ, these delicate structures are either partly or quite destroyed."

ELECTRICAL ILLUMINATION.

Mr. Woolman : "The incandescence lamp which I have brought for exhibition, is the Swan lamp. The arc is very small and is, I think, well adapted for the resolution of fine lines, like those of the *Pleurosigma angulatum.* The lamp is suspended from the end of a jointed arm attached to an independent support, and is under the complete control of the operator. The electricity is generated by a Grenet battery of two cells, each containing a zinc and a pair of carbons."

The President requested a free expression of views on the subject of the electric light.

Mr. C. F. Cox : "The inquiry into the advantages of electrical illumination in microscopy is becoming a prominent one, and the impression will naturally arise that this kind of illumination is destined to supersede all others. Two things claim attention and discussion,—the lamp and the light. In the form of the lamp there is room for great variety, and on the merits of each variety opinions may differ. But the chief question is, What is the quality of the light itself, and for what uses is it fittest? Its quality places it between lamp light and direct sunlight, but nearer to the latter than to the former. Now, as direct sunlight is not suitable for opaque objects, since by diffraction it confuses their structure by creating deceptive appearances, so the electric light is, in my opinion, objectionable in the ratio of the nearness of its intensity to that of direct sunlight. For the study of opaque objects under low-power objectives, I find lamp light to be the best, its character as a more diffused light fitting it for the coarser kinds of work, such as the exhibition of elytra. In the examination of such transparent objects as require high-power objectives, the electric light is undoubtedly the more effective. The point which I wish to make is, that no single kind of artificial light has sufficient versatility for the best performance of every one of the many and diverse varieties of work to which the microscope is applied."

Dr. F. Y. Clark : "At first I doubted the serviceableness of the electric light in microscopy. But when by means of it I found myself able to distinguish good, velvety gold foil from poor foil, then I began to prize it. In poor foil are minute holes and fractures, from which the good foil is free. These are detected by the electric light, while the light from an oil lamp does not disclose them."

Mr. P. H. Dudley : "As the result of eight months' trial of the electric light in photomicrography, I found that success demands the employment of a short, thick carbon filament, and the heating of the filament to a degree of incandescence that is scarcely below the destructive point. If the heat go a degree or two higher, the lamp is destroyed. I used the bichromate battery, of eight cells, with double plates, seven inches by eight, in each cell. Apart from considerations of expense, and the extreme difficulty of securing an even current of the requisite strength, the electric light is the best for photography. These drawbacks, however, led me to abandon its use."

The President : "The work of applying the electric light to the microscope is yet in its infancy. What form of lamp is best for general use has not, perhaps, been determined. Probably several forms will be required, to suit different purposes. Only by the skill and industry of many men can the problem be solved. The electric light is of pure and excellent quality. But, in practice, the height to which its brilliancy can be carried, is limited. For I have found that as soon as the light has reached perfect whiteness, or has acquired a bluish tint, the heat destroys the lamp. The inconvenience arising from the rapid exhaustion of the strength of the electric current, may be partly obviated by the use of a storage battery. I have seen this device employed with marked success."

BACILLUS LEPRÆ AND BACILLUS TUBERCULOSIS.

Mr. E. A. Schultze read a translation which he had made, of an article recently contributed by Dr. P. Baumgarten to the "Zeitschrift für Wissenschaftliche Mikroskopie," on "Methods for Determining the Difference between *Bacillus lepræ* and *B. tuberculosis.*" Its purpose was to show that these bacilli, though nearly identical in form, may be correctly and easily distinguished from each other by coloration ; and it describes four processes of staining, three of which are given below.

First Process:

1. Pour five or six drops of saturated alcoholic solution of fuchsine into a small watch-glass containing distilled water.

2. Float on the dye for six or seven minutes several dry cover-glasses laden with fresh bacilli.

3. Decolor for fifteen seconds in absolute alcohol mixed with nitric acid in the proportion of ten parts to one.

4. Put into distilled water in order to remove the acid.

5. Moisten with aqueous solution of methylene-blue, and examine at once with a $\frac{1}{12}$th-or $\frac{1}{18}$th-inch homogeneous-immersion lens ; and the *Bacilli lepræ* will show themselves as well-defined red rods, while the *B. tuberculosis* will present no color whatever.

Second Process:

1. Place for not more than fifteen minutes the bacilli-bearing material into the fuchsine solution above described.

2. Decolor for thirty seconds in the mixture of alcohol and nitric acid.

3. Wash in distilled water.

4. Dehydrate in absolute alcohol three or four minutes.

5. Put into oil of bergamot, and examine with homogeneous-immersion objective. The *Bacilli lepræ* will be easily recognized as shining red rods on a blue ground, while nothing will be seen of the *B. tuberculosis.*

Third Process:

1. Place the bacilli-bearing sections for two or three minutes

into Ehrlich's solution of fuchsine, which is composed of eleven parts of saturated alcoholic solution of fuchsine and one hundred parts of aniline-water.

2. Decolor for thirty or sixty seconds in the nitro-alcoholic mixture.

3. Dip the sections for two or three minutes in aqueous solution of methylene-blue.

4. Dehydrate in absolute alcohol three or four minutes.

5. Transfer to oil of bergamot, and examine with homogeneous-immersion lens. The lepra-bacilli will be seen colored red, while the tubercle bacilli will not be marked at all.

THE CHOLERA BACILLUS.

L. Schöney, M. D., said: "The study of pathogenic bacteria is one of great importance. The views of Dr. Koch, a pioneer in this work, and one of the keenest of investigators, have met with much opposition, and this opposition has sharply assailed his latest promulgated discovery of a micro-organism specific of Asiatic cholera,—the comma-bacillus. Dr. Lewis stated that this form is found in the saliva of perfectly healthy persons, and Drs. Finkler and Prior asserted its existence in cases of cholera nostras ; but Dr. Koch has shown that these gentlemen did not make the requisite pure culture. The curved bacilli in saliva and of cholera nostras are longer, more slender, and less blunt at the ends, and, more important still, do not grow in an alkaline peptone gelatine. Only the bacillus of Asiatic cholera develops in that. The crucial test recently made in the Berlin Hygienic Laboratory, of inoculating with the cholera bacillus, was repeatedly successful."

Dr. Britton : "The researches of the Rev. W. H. Dallinger on the 'Least and Lowest Living Things'[1] are of great interest as demonstrating that, however similar to one another these forms may appear, their difference will certainly be detected through a study of their life-history."

Meeting of December 19th, 1884.

The President, Mr. C. Van Brunt, in the chair.

Twenty-eight persons present.

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[1] See "Nature," Oct. 23d, and Oct. 30th, 1884.

Mr. P. H. Dudley and Mr. C. W. McAllister were elected Active Members of the Society.

The following objects were exhibited:—

Radial longitudinal section of Tamarack (*Larix Americana*), showing medullary rays and starch grains : by P. H. DUDLEY.

Fibro-cells of *Pleurothallis ruscifolia* : by M. M. LE BRUN.

Transverse section of Mandrake : by J. L. WALL.

Æcidium ranunculacearum : by WALTER H. MEAD.

The " Electric Spark," prepared by Mr. E. G. Day : by H. M. DICKINSON.

A New Microscope Stand, furnished by Mr. Green, successor to Mr. Tolles : by J. WARNOCK.

An Improved Portable Microscope, made by Mr. Zentmayer : by C. S. SHULTZ.

Mr. Dickinson said: "The 'Electric Spark' which I am to exhibit, is made by the passing of electricity through a tiny Geissler tube. The tube is mounted in a deep cell, and is viewed through the microscope."

Mr. Shultz : " Wishing a microscope which should embody, so far as is possible, the excellent qualities of the Army Hospital, the Histological, and the Portable Stands of Mr. Zentmayer, I procured of that maker the instrument which you see in my hand. Besides other desirable features, it has a rotating stage, a mirror of good size, and a large optical body."

Mr. William Wales (in answer to an inquiry) : "The advantage of a large over a small tube is connected mainly with the use of the A eye-piece, because that eye-piece, having a larger field-lens, can have a larger diaphragm and thus command an ampler field. Liking to make the parts of a microscope to harmonize with one another and with the size of the whole instrument, manufacturers naturally attach a small tube to a small stand."

The microscope which was exhibited by Mr. Warnock is, practically, a Tolles stand. Mr. Tolles was the author of all the drawings and specifications, and some of the castings were made before his death. The instrument was finished under the direction of Mr. Charles X. Dalton, who was Mr. Tolles's worker in brass.

Mr. Shultz urged the Society to devise some plan for the mutual exchange of mounted objects and other microscopical material.

The President appointed Mr. Wall, Mr. Shultz, and Mr. Mead a Committee of Nomination to prepare a list of names of Members to be recommended by them for election as officers for the ensuing year, and the Committee were instructed to present their report at the next regular meeting of the Society.

THE MEDULLARY RAYS OF THE TAMARACK.

Mr. P. H. Dudley said: "My 'section' of the wood of the Tamarack was made while the wood was green. Disturbance of the cell-contents,—starch, resin, etc.,—by boiling, was thus avoided. The tree was felled on the 27th of November, and it had fourteen annular rings, eight of which were duramen. I have examined the ligneous tissue of thirty species of Coniferæ, and have observed in the medullary rays of the Tamarack a great variety of interesting features, some of which distinguish this from the other species, with the partial exception of the White Spruce.

"A tangential section exhibits most of the medullary rays in single plates. When the plates number two or more, they usually inclose a large canal, and then the section of the bundle is lentiform in contour.

"In the radial longitudinal section, small lenticular cavities of the peculiar kind which marks all conifers in their tangential section, are exhibited in abundance in the one or two series of cells at each of the two margins of a medullary plate. The septum separating the divisions of a double-convex cavity is strongly thickened at its centre. Some of the cavities are plano-convex, having no counterpart on the other side of the cell wall. The walls of the cells that lie between the two marginal tracts, show lenticular cavities rarely, and then, except occasionally in the central row or rows, in only a half-developed state. Instead, they exhibit pits of the shape of wells and of funnels, extending to the boundary lamella but never through it. Neither these pits nor the lenticular cavities are evenly distributed, being at some points scattered, at others clustered.

"The ends of the cells are almost universally oblique to the sides, and their section is oftener curved than straight.

"The openings communicating between the marginal ray-cells and the vertical cells next to which they lie, are generally circular in form, and centrally perforated, like the bordered pits seen in the vertical cells, but much smaller than those. Of the rest of the openings, some are oblong, some elliptical; and the axes of these fissures, following the striations of the walls of the upright cells, are parallel to one another.

"In the marginal cells of a medullary plate, I have discovered no starch grains, but in the intermediate rows of cells they abound, especially in the alburnum. Their quantity gradually decreases in the duramen, and in the pith they are almost wanting. The grains are ovoid, and have but two-thirds the size of those in rice."

MISCELLANEA.

That Man is certainly the happiest, who is able to find out the greatest Number of reasonable and useful Amusements, easily attainable and within his Power: and, if so, he that is delighted with the Works of Nature, and makes them his Study, must undoubtedly be happy; since every Animal, Flower, Fruit, or Insect, nay, almost every Particle of Matter, affords him an Entertainment. Such a Man never can feel his Time hang heavy on his Hands, or be weary of himself, for want of knowing how to employ his Thoughts: each Garden or Field is to him a Cabinet of Curiosities, every one of which he longs to examine fully; and he considers the whole Universe as a Magazine of Wonders, which infinite Ages are scarce sufficient to contemplate and admire enough.—*Henry Baker, in "The Microscope Made Easy," published at London in* 1742.

——'If fresh green leaves be immersed in boiling water and afterwards in alcohol, their chlorophyll is extracted without rupture of the cells, and the leaves become blanched. Placed then in a strong alcoholic solution of iodine, the decolored leaf will be stained a buff-yellow if no starch be present, and blue-black if much be present; and there will be intermediate shades of color corresponding to intermediate amounts of starch.

'The formation of starch is dependent on light. The starch formed in the leaf during the day, may disappear completely during the night. It disappears in the form of soluble glucoses which travel through the vascular bundles to the growing parts of the plant. Though this process takes place chiefly in the night, it goes on slowly by day also, but is then masked by the much more energetic production of starch.'—*Prof. J. Sachs.**

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*Cf. Jour. Roy. Mic. Soc., IV. (1884), p. 589; also Sci.-Gossip, 1884, p. 273.

——More microscopy can be learned and more knowledge acquired by ten hours' devotion to the original investigation of anatomical structure or of physiological phenomena, than by a hundred hours of surrender to the amusement of trying or to the pride of parading one's lenses by examining mounted test-objects only. The glory of a lens, like that of a man, is work.

——In looking for cyclosis in plant-cells, care must be taken to distinguish protoplasmic action from the oscillatory movement called "Brownian," and from the motions of bacterial organisms. By the practised eye these phenomena are easily discriminated. The caution is given for the benefit of the inexperienced observer.

——THE MINUTENESS OF SPORULES.—Bacteria increase by repeated self-division. But sometimes the multiplication is effected by the production of sporules. The sporules of the micro-organisms which develop in an aqueous solution of sulphocyanide of potassium, and of sundry other chemicals, are so small that they will pass freely through a dozen or more thicknesses of the finest filter-paper. The smallest sporules known are, probably, those of *Bacterium termo*. A lens of the finest quality, magnifying five thousand diameters, failed to disclose them to the keen and watchful eye of Dr. Dallinger. Their immense numbers gave them the aspect of a homogeneous, glairy, clouded fluid. But this experienced observer knew that they must presently, through increase of size by growth, become visible in their individuality; and at the end of nearly two hours they began to display themselves throughout the field with the 'suddenness and beauty of the apparition of the stars at nightfall.'

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COMPOUND EYES AND MULTIPLE IMAGES.

BY J. D. HYATT.

(*Presented January 2d*, 1885.)

My microscopical recreations the past summer were directed mainly upon the structure of the compound eyes of insects, not so much for a definite scientific purpose, as with the practical object of discovering what insects have eyes that are the most serviceable for showing multiple images under the microscope. The results thus far obtained are far from exhaustive ; yet I have fallen upon some curious features in the structure of these organs, which may possess the interest of novelty to an audience not composed exclusively of entomologists.

These compound eyes, consisting externally of a great number of lenses, sometimes exceeding twenty thousand, set in a framework of convex or, often, hemispherical form, have a range of vision, or "angular aperture," very much larger than could be commanded by a simple eye of the same convexity. For, while the simple eye could form correct images of those objects only which are situated within the range of rays passing through its optical axis, the minute lenses composing the compound eye may, many of them, receive light from a horizon as low down as the base of the entire set, if not lower.

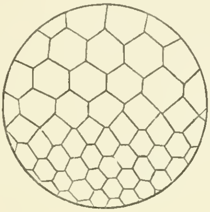
In some species of Neuroptera the head is nearly cylindrical, and is placed with its axis transverse to the axis of the insect's body. As the eyes, constituting, of course, the extremities of the cylinder, have a diameter exceeding that of their support, and are, besides, hyperhemispherical, they give to the head the appearance of a dumbbell. Were one of these insects placed at the centre of a hollow sphere, it could, undoubtedly, see at the same moment every point of the sphere's interior surface.

The *Gyrinus*, or Water-beetle, which may be seen sporting on the surface of still water in summer, has the unusual number of four compound eyes. Besides the usual pair on the upper and frontal part of the head, set in the under side of the head is another pair, looking directly downward and completely submerged—"water-immersion" eyes. The utility of this arrangement is readily seen. Its anatomy I have not myself examined; but I have somewhere heard or read that the two eyes on each side, though separated externally, are, in a measure, connected internally. The *Gyrinus* is the only example of this peculiar structure that has come under my observation.

To those who admire color, a microscopical observation of the eyes of living insects, especially those of the order Diptera, and of the night-flying Lepidoptera, will be fruitful of delight. For the eyes of these insects display an endless variety of colors which vie in brilliancy with the most lustrous of the "bright jewels of the mine." After the death of the insect, however, the color soon disappears.

In mounting compound eyes for the purpose of showing multiple images, the first step, after carefully washing the interior of the cornea, is to press the cornea flat, so that all the lenses may lie as nearly as possible in the same plane. But as this operation necessarily occasions either a breaking or a folding of the cornea, I cut out, with a small punch made for the purpose, a circular disk not larger than can be pressed flat without disturbing the facets. In punching out these disks, a single cutting gives two circular pieces, showing that the cornea is double; and in the eyes of *Cicada*, a single cutting gives three separate disks, showing a triple set of lenses in the cornea. Each set constitutes, without doubt, an achromatic combination.

In some of the Diptera, particularly of the genus *Tabanus*, or Horse-fly, the lenses of the upper and anterior part of the eye are much larger than those situated below a median line. A disk cut from one of these eyes in such a way as to include a number of the upper, or larger facets, and also some of the lower, is represented in the accompanying diagram. It will be observed that the larger facets have, at least, twice the diameter of the smaller, or four times their superficial area. A still more remarkable feature, however, is the difference in focus between the larger lenses and the smaller. For upon placing this part of the eye upon the stage of the microscope, and adjusting the focus for multiple images, I found that the larger lenses form pictures at a plane considerably above the focal plane of the smaller ones. From this fact it would appear that these insects are furnished with eyes of two varieties, corresponding to our long-sight and short-sight spectacles ; in other words, telescopic and microscopical eyes, the telescopic looking upward and forward, and the microscopical downward. The economy of such an optical structure in a parasitic insect which seeks its prey at a distance, is so obvious that I need not stop to explain it.



For showing multiple images, the most perfect eyes that I have yet found are those of *Blatta orientalis*, or the Cockroach. As the eyes of this insect are quite brittle, only a small part of the cornea can be pressed flat in one piece. Yet a piece large enough to fill the field commanded by a half-inch objective and a *B* ocular can be cut out with the punch. The many advantages which it possesses, more than counterbalance its lack of superficial extent. For the lenses are very transparent, and comparatively large, and, being set in a moderately hard framework, do not separate so as to destroy the achromatic combination. Nor do the lenses which make up each combination slip upon one another when subjected to slight pressure, as do the lenses in the eyes of most other insects except the Coleoptera. When the lenses do thus slip upon one another, each separate eye shows two or three imperfect images instead of a single good one. The chief advantage, however, which the eyes of the Cockroach possess over all others is that they may be mounted in glycerine and thus kept perfectly transparent without losing their properties as lenses.

The usual method of exhibiting the multiple images is to place the mounted cornea of the compound eye upon the stage, and focus the microscope so much above it as to show a clear circle of light in each facet. Then, if any small object be placed between the stage and the mirror, its image will be exhibited by every lens. Also if a small letter, figure, or picture, in black, with a clear, white background, be placed one or two inches below the stage, and a strong light be condensed upon it, it will be seen with tolerable distinctness. Such objects are, however, much more sharply defined if first cut out, and then pasted upon a thin cover-glass, which may be mounted on the substage. In this situation the object is illumined by light reflected from the mirror. The effect will be still better if a slip of ground glass be interposed between the object and the mirror, so as to shut off the image of the lamp, if lamplight be employed, or of distant objects, if daylight be used. The eye of a mosquito will show two or three hundred pictures of a person, in silhouette, with great distinctness, provided you have a window so situated as to allow light from the sky or from a white cloud to pass unobstructed to the mirror. The person must stand at a distance of five or six feet from the microscope, and with the profile of his face in clear relief against the sky. The plane mirror must, of course, be used.

I have recently been much interested in examining the structure of the eye of *Limulus*, or the Horse-shoe Crab, which, though compound, is quite different, in some particulars, from that of insects. The exterior of this eye is perfectly smooth, and consists of a transparent horny coat of considerable thickness. The concave interior surface is studded with lenses varying in form from plano-convex, near the centre, to conical and paraboloid, toward and at the periphery. These lenses are so placed that their optical axes converge to a common point situated in a plane a little below the base of the whole eye. This point, without doubt, is occupied by the retina, or the extremity of the optic nerve. Good multiple images will be made by this eye if a small disk cut from the central part be used, the eye being flattest at that point and the lenses least conical. From any other part of the eye it would be extremely difficult to cut a disk that would not, in consequence of the oblique position of the lenses, greatly distort the images.

Multiple images may be formed under the microscope in many other ways than by the use of compound eyes. The minute plano-convex bodies of water produced by breathing on a slide, will display good images of any small object supported above the mirror. In like manner, images will be made by other transparent bodies, or by the transparent parts of any structure, which are of lenticular or globular form.

Concave lenses, as well as convex, will give images, but with this difference,—the images will be found below the plane of the foci of the lenses, and will be inverted ; whereas, images produced by convex lenses are formed erect and, as before stated, at a plane above such focus. It follows that air-bubbles in water will yield inverted images, the water immediately surrounding them acting as a biconcave lens.

These facts may possibly be of some service in determining the character of minute bodies or structures, such, for example, as human blood corpuscles, all of which show erect images—a proof that they are nucleated or, at least, lenticular at the centre. The head of the pin-shaped sponge-spicule, and the nuclei in certain diatoms, produce inverted images.

HETEROMEYENIA RYDERI.

BY PROF. SAMUEL LOCKWOOD, PH.D.

(*Read January 16th*, 1885.)

While summering in 1883 at Twin Mountain, N. H., Mr. F. W. Devoe and myself did some object-hunting for the microscope. On pulling up some submerged sticks from a still pond in a field, we observed that they were encrusted with certain green, moss-like prominences, which proved to be specimens of a fresh-water sponge. The species has been determined by Mr. Edward Potts to be *Heteromeyenia Ryderi*. Mr. Devoe has prepared an interesting mount of the sponge, on which, at this gentleman's request, a few remarks are herewith offered.

By reason of the green color, the amateur, on first seeing a specimen of Spongilla, is invariably deluded into the belief that he has found a peculiar species of confervoid alga. The color is owing to the abundance of chlorophyll in the sarcode of the sponge. This sarcode, or pseudo-flesh, is composed largely of undifferentiated, that is, structureless, protoplasm ; the rest, consisting of the differentiated protoplasm, is composed of flagellate cells not unlike ciliated monads.

It may be remarked that the Spongida, or Porifera, are divided into three great groups, according to the substance which makes up the skeleton. If the skeleton is composed of keratose, that is, of horny matter, as in the sponge of commerce, the group is known as the Keratosa. If the skeleton consists of lime, the group is known as the Calcarea, or Calcispongia ; and if the skeleton is made of silica, the group is called Silicea. To the last group belongs the fresh-water sponge, in which the skeleton is made up of very fine spicules of silica. Knowing this fact, the amateur needs not to be deceived by the green aspect of his specimen, when it is found fresh and occupying its native habitat ; for, instead of the simple gelatinous feel of the conferva, our little Spongilla, when taken between the fingers, imparts a crinkly feeling due to the presence of these spicules of silica.

The sponge was long regarded a vegetable ; and in Japan, I am told, the term for sponge literally means "sea-cotton." Biologists to-day agree in assigning the Spongida to the animal kingdom. Indeed, if one of the flagellate cells, or "separate sarcoids," with some protoplasm adhering, be carefully detached from a colony, it will move about with its vibrating cilium, and, like an Amœba, will project the adhering protoplasm into many pseudopodia, or false locomotive organs, of never ceasing change as to form and number.

When first studied abroad, the fresh-water sponge was put into a genus, *Spongilla*, containing two species, *S. lacustris*, and *S. fluviatilis*. Afterwards the genus *Meyenia* was erected, into which *S. fluviatilis* was placed ; and, later, the other species became known as *S. lacustroides*. It is an interesting fact, that these two European species have American representatives.

The specimen of *Heteromeyenia Ryderi* mounted by Mr. Devoe, will prove highly interesting, if attention be directed to the following objects, easily observed upon the slide.

1. The skeleton spicules. These are of pure silica, and very translucent, but do not polarize well. They are slightly arcuate, or bow-shaped, in form, and are exquisitely sharp at both ends. Indeed, in respect of sharpness, no cambric needle is comparable with them. Shown under high powers, these tiny bows are not uniformly smooth, but are occasionally studded with very minute spurs.

The economy of this studding of the spicules with these pointed spurs is, I think, plain, and is really beautiful. They help the spicules to felt together and thus sustain in position, the simple structure of living jelly, with its system of aqueducts for the distribution of the alimentary supply, and also with its system of oscula, or sewer outlets of the effete water. These are sometimes called the dermal or flesh spicules, because their office is to bind together the sarcode of the colony.

2. The next notable objects are the yellow spheres scattered among the skeleton spicules. Formerly they were known as gemmules, but now they are oftener called statospheres, and statoblasts. These are the reproductive bodies. They are sometimes called the winter eggs—a significant, though not scientifically accurate term. They may be compared to capsules filled with very fine seeds, since they are stored with reproductive germs, of which each has several hundreds. These pretty golden spheres are produced at the close of summer, shortly before the death of the colony—for the sarcode perishes at the approach of the cold season. The sporules, or germs, of the statosphere survive the winter, and with the first warm weather they leave their spherical nest by a hole at one side of the sphere.

3. Here and there in the mount may be noted one or more yellowish granules. They are sporules which have been liberated in the breaking down of the statosphere by the nitric acid used in preparing the mount. I think it owing to the acid that these sporules are seen as granular, or not homogeneous bodies. It may be added here that these germs thus set free in spring, either start new colonies by attaching themselves to submerged sticks or stones, or, as is frequently the case, they settle upon the little heap of skeleton spicules of the extinct colony, and so actually rehabilitate and enlarge the defunct establishment.

4. These statospheres, or winter eggs, are held entangled in the felted mass of the skeleton spicules in the same way that the bur of a burdock is held in place when put in the hair of a boy by some mischievous playmate. Each bristly hair of the bur is hooked. So it is with the exterior of these globular bodies. To keep them in place in the felted skeleton, the surface of each statoblast is studded with tiny spicules, each one of which is birotulate, or two-wheeled; that is, it has an axle connecting the two wheels and consolidated with them, like the bobbin, or spool, on which thread is wound. This shaft connecting the two little wheels is so held in the shell, or outer coat, of the statosphere,

that one wheel of the bobbin is inside of the shell. like the rivet-head in a boiler, and the other wheel is outside of the shell, and projects a little in order to be entangled in the felting of the skeleton spicules of the body mass of the sponge. I have likened these little spicules on the statoblast to a bobbin, or spool. Their technical name, though in English, is somewhat formidable, since they are known as the "short birotulate statosphere spicules."

5. This brings us to another point of interest. Interspersed somewhat sparingly among these short birotulate spicules, which are practically innumerable, is another double-headed spicule, of about twice the length of those just described, and differing from them greatly in the character of the two ends. Technically it is termed birotulate. This word, however, is not so accurately descriptive of these, as it is of the bobbin-shaped spicules. These long statosphere spicules deserve to be called double-grapnels; for each end is, not a wheel, but a series or circle of hooks. In this way extraordinary holding power is afforded, to secure the statoblast during its winter stay in the skeleton of the colony.

Generally the shaft, or axle, of the short bobbin-like spicule is smooth, though it is sometimes a little spurred. But in the larger, or grapnel spicule, the spurring of the shaft is so frequent and so pronounced, as to excite curiosity regarding its function. I hardly dare attempt an interpretation, farther than to suggest that this arrangement gives to the shaft a steadier hold in the shell of the statosphere.

PROCEEDINGS.

Meeting of January 2d, 1885.

The President, Mr. C. Van Brunt, in the chair.

Thirty-four persons present.

Mr. Edward A. Caswell was elected an Active Member of the Society.

The Special Committee appointed at the meeting of December 19th, to nominate a list of officers for the ensuing year, presented their report.

The following objects were exhibited :—

Bacilli from *Pneumo-enteritis* : by W. H. Bates, M. D.

Stephanodiscus Niagaræ, mounted in balsam of Tolu : by Edward G. Day.

Pond-life : by A. D. Balen.

Surirella (seventy-four forms ; mounted by Möller) : by E. A. Schultze.

An Electric Lamp : by R. W. St. Clair, M. D.

MICRO-ORGANISMS OF PNEUMO-ENTERITIS (SWINE PLAGUE).

Dr. Bates said: "The specimens of bacilli which I have brought for exhibition, were derived from swine at Flatbush, L. I. There is some controversy as to the character of the micro-organisms which are specific of *Pneumo-enteritis*. Some observers consider them to be micrococci, while Dr. Klein places them with the bacilli. My specimens evidently belong to the latter class. They are identical with those figured by Dr. Klein in his writings on this subject."

STEPHANODISCUS NIAGARÆ.

Mr. Edward G. Day : "*Stephanodiscus Niagaræ*, a diatom of great beauty, occurs abundantly in the river Niagara and in Lake Erie. My specimens were obtained in Cleveland, which gets its supply of water from the lake. They are easily procured by tying over a faucet a linen-cambric handkerchief, and letting the water drip through it several hours.

"On account of the high refractive index of balsam of Tolu, diatoms mounted in it show brighter, and exhibit their structure more clearly, than when Canada balsam is used. The work of mounting, however, has to be finished at once, otherwise the balsam is likely to crystallize under the edge of the cover-glass. This medium is best prepared for use by dissolving it in chloroform, and carefully filtering the solution. The method of mounting with it is similar to that with ordinary balsam. When the work is done, the chloroform is expelled by one or two days' exposure to gentle heat."

The President said that his own observation accorded with the statement of Mr. Day regarding the tendency to crystallization ; that he had himself seen slides of diatoms which, though prepared by an experienced hand, had become impaired through the crystallization of the mounting medium.

MULTIPLE IMAGES.

Mr. J. D. Hyatt gave his observations on the formation of multiple images by compound eyes. They are printed in full on pages 33–37.

A NEW ELECTRIC LAMP.

The incandescence lamp which was among the objects exhibited, was described, and its quality and working illustrated, by R. W. St. Clair, M. D. "The battery," said he, "has six cells, for one filling of which about five ounces of fluid are required. The arc in the lamp is a vein of the beech leaf, carbonized. Its life is long. I have one which has been in use more than a year. The light is readily governed by making connection with more or fewer of the cells. It has been tested in photomicrography with satisfactory results."

The President remarked that the electric light exhibited by Dr. St. Clair is the best for brilliancy that has yet been brought before the Society.

Mr. E. A. Schultze stated that Dr. Van Heurck is employing electrical illumination in photographing diatoms, and that his work, which can but be of great interest and value, will soon be given to the world.

MICRO-ORGANISMS OF PNEUMO-ENTERITIS.

Mr. R. Hitchcock, of Washington, was present, and the President invited him to favor the Society with any observations which he was pleased to make. He responded : "I brought with me two preparations, both excellent, which I thought would interest you. One is of the *Bacillus tuberculosis*, the other is of micrococcus. As has been stated by Dr. Bates this evening, observers differ in opinion as to the relation between bacterial organisms and *Pneumo-enteritis*, or swine-plague. Dr. Klein has decided in favor of the bacillus, and has maintained his position a long time ; but I think that the evidence is decidedly against him. Recently, Dr. Salmon has demonstrated the presence of micrococcus in swine-plague; and a few days ago I received a note from Dr. Sternberg, informing me that he had himself just obtained a pure culture of the micrococcus of this disease, while previously he had seen only the bacillus. The credit of the discovery of micrococci he freely accords to Dr. Salmon. The study of micrococcus is perplexing, because of the invariable presence of bacilli in the material examined, and because of the greater ease of finding them than of finding micrococci."

ELECTION OF OFFICERS.

The President announced the closing of the polls, and the following was declared to be the result of the balloting :—

For President, CORNELIUS VAN BRUNT.
For Vice-President, C. F. COX.
For Recording Secretary, A. D. BALEN.
For Corresponding Secretary, EDWARD G. DAY.
For Treasurer, M. M. LE BRUN.
For Librarian and Curator, W. G. DE WITT.
For Auditors; { EDWARD C. BOGERT,
FREDERICK W. DEVOE,
WILLIAM R. MITCHELL.

MEETING OF JANUARY 16TH.—THE ANNUAL MEETING

The President, Mr. C. Van Brunt, in the chair.

Thirty-six persons present.

The second regular session of the Society in January is the Annual Meeting. At this meeting the officers present their Reports.

REPORT OF THE PRESIDENT, ON THE STATE OF THE SOCIETY.

" My Report," said the President, " will be brief. The Society is to be congratulated, both on account of the attendance during the past year, and on account of the character and amount of the work done. The roll of Active Membership now embraces fifty-five persons—an increase of nine. The number of Honorary Members is eight; of Associate, twenty-two. The total membership is, therefore, eighty-five. The attendance has averaged twenty members and sixteen visitors. Including the Paper which is to be read this evening, the record of Papers presented will be as follows:—

1. Feb. 15th.—The Wine-Fly (*Drosophila ampelophila*). By PROF. SAMUEL LOCKWOOD, PH.D.
2. Mar. 7th.—A Plan for the Exchange of Object-slides and other Microscopical Material, among the Members of the Society. By C. S. SHULTZ.
3. Mar. 21st.—The Microscope One Hundred Years Ago. By B. BRAMAN.
4. Apr. 18th.—Embryology of the Batrachia, with Illustrations from the Axolotl. By H. J. RICE.
5. May 2d.—The Gold-sands of California. By C. H. DENISON.
6. May 16th.—Textile Fibres. By T. M. LETSON.
7. June 6th.—Notice of a New Fungus, *Appendicularia entomophila*, Peck, parasitic on the Fly *Drosophila nigricornis*, Loew. By the Rev. J. L. ZABRISKIE.
8. June 20th.—The Photomicrography of Woods By P. H. DUDLEY.
9. Nov. 7th.—Electrical Illumination in Microscopy. By E. A. SCHULTZE.
10. Nov. 21st.—Criticisms on Mr. J. Kruttschnitt's Papers and Preparations Relating to Pollen-tubes. By N. L. BRITTON, PH. D.
11. Dec. 5th.—Methods for Determining the Difference between *Bacillus Lepræ* and *B. tuberculosis*. Translated from the German, by E. A. SCHULTZE.
12. Jan. 2d.—Compound Eyes and Multiple Images. By J. D. HYATT.
13. Jan. 16th.—*Heteromeyenia Ryderi.* By PROF. SAMUEL LOCKWOOD, PH.D.

"These Papers, mainly unsolicited, have added much to the scientific value of our sessions. The meetings have, besides, had a pleasantly social character. I can express no better wish in behalf of the Society than that the delightful features of our year just past, may continue through the coming year."

SUMMARY OF THE REPORT OF THE TREASURER,
MR. M. M. LE BRUN.

Balance, Jan. 18th, 1884,	$ 31.94	
Receipts, to Jan. 16th, 1885,	310.00	$341.94
Disbursements, to Jan. 16th, 1885,		316.00
Balance, Jan. 16th, 1885,		$25.94

OBJECTS EXHIBITED.

The objects exhibited were,

1. Fresh-water Sponge: by F. W. Devoe.
2. Sponge Spicules: by J. D. Hyatt.
3. Spiracles of House-Fly: by A. G. Leonard.
4. Tongue of Fly, with Pseudo-tracheæ flattened: by F. W. Leggett.
5. *Buthus Carolinianus*, showing Ocelli: by B. Braman.
6. Stomach of Carolina Locust: by Horace W. Calef.
7. Brain of Rat, injected (mounted by Cole, of London): by Edward G. Day.
8. *Acer campestre*, transverse section, double-stained: by J. L Wall.
9. *Taxus brevifolia*, tangential section: by J. L. Zabriskie.
10. Leaf of *Leucophyllum Texauum*, showing Ramose Hairs: by E. A. Schultze.
11. Leaf of *Magnolia grandiflora*, showing Hairs: by W. G. De Witt.
12. *Polyporus sanguineus*, a Fungus: By W. G. De Witt.

FRESH-WATER SPONGE.

The specimen of fresh-water sponge (*Heteromeyenia Ryderi*) exhibited by Mr. Devoe, was obtained from a pond at Twin Mountain, N. H., in the summer of 1883. Dr. Samuel Lockwood, the companion of the exhibitor in that excursion, prepared a written description of this object, embracing also observations on the life-history of this genus of sponge, and presented it to the Society. It was read before the Society by Mr. Hyatt, and it is published in full in this Number of the Journal.

DIMENSIONS OF SPICULES OF HETEROMEYENIA RYDERI.

Mr. Hyatt had measured the spicules of *Heteromeyenia Ryderi*, and he gave the result, as follows:—

Largest pointed spicules: average length, $\frac{1}{100}$th of an inch.

Grappling-hook spicules: average length, $\frac{2}{100}$ths of an inch.

Short birotulate spicules: length, from $\frac{1}{1000}$th to $\frac{1.5}{1000}$ths of an inch.

Wheels of short birotulate spicules: average diameter, $\frac{8}{10000}$ths of an inch.

OBSERVATIONS ON FRESH-WATER SPONGE.

Mr. Hyatt said that fresh-water sponge—but not of the species exhibited by Mr. Devoe—abounds in the Bronx River, attaching itself to sunken brush-wood; also, that it occurs in great quantity in the Erie Canal.

The President: "There is a vigorous growth of sponge on the filter-beds through which passes the water-supply of Poughkeepsie; and, at one time, the decay of the gelatinous substance of the sponge imparted to the water an unsavory taste."

Mr. Devoe (in response to an inquiry): "My specimen was mounted dry, after maceration in dilute nitric acid. By such maceration some of the spicules are, it is true, disengaged from the statosphere; but, when caution is exercised, enough spicules are left to show with how great beauty they are distributed over the surface of the sphere. For the discovery of the full beauty of an individual spicule, a high-power lens is necessary."

Dr. Bates: "I have been informed by Mr. Henry Mills, of Buffalo, that for a permanent mount of fresh-water sponge, carbolic acid is the best medium."

Mr. Balen: "This sponge will keep indefinitely when once dried. The animal matter decays; the rest remains. The general shape of the sponge is preserved, and the spicules are left undisturbed."

TAXUS BREVIFOLIA.

Mr. Zabriskie: "*Taxus brevifolia* is a remarkably dense and durable wood. My section of it shows the spiral fibres of the wood-cells in great abundance."

LEUCOPHYLLUM TEXANUM.

Mr. Schultze: "The hairs on the leaf of *Leucophyllum Texanum* are curiously and beautifully branched, and are a very pleasing opaque object for the microscope. They are densely crowded, and some of them have as many as twenty ramifications. I am indebted for my specimen to Dr. Britton."

Dr. Britton: "*Leucophyllum* is a genus of low, branching, shrubby plants indigenous to Mexico and the southwestern part of the United States. Three species are known. They bear axillary, showy, violet-purple flowers. *L. Texanum*, Benth., grows to a height of from two to eight feet, and has silvery-white, obovate, nearly sessile leaves, half an inch in length. The specimen is from San Diego, Texas."

EGGS OF LIMULUS POLYPHEMUS.

Dr. Julien: "I have the pleasure of presenting to the Society some specimens of eggs of *Limulus Polyphemus*, the gift of Prof. W. B. Dwight, of Poughkeepsie; also, some infusorial earth, collected near Vancouver Barracks, Washington Territory, by Dr. Timothy E. Wilcox, U. S. A."

Prof. Dwight sent, with his gift, a letter conveying the following information: 'These eggs of *Limulus Polyphemus* are nearly mature. They were found last summer, buried two or three inches in the sand, at a locality three miles south of Cottage City, Martha's Vineyard. It was difficult to separate them from the sand without injuring them, so delicate is the outer membrane. For their preservation, I know of no better medium than dilute alcohol.'

The membrane alluded to is transparent, and the young *Limulus* is seen quite clearly. The eggs are spherical, and their diameter is three-twentieths of an inch, very nearly.

A copy of "Desmids of the United States," a gift from its author, the Rev. Francis Wolle, was added to the Library.

INDEX TO ARTICLES OF INTEREST TO MICROSCOPISTS WHICH HAVE RECENTLY APPEARED IN OTHER JOURNALS.

Amœba, The, and the Cell : C. H. STOWELL.
The Microscope, IV. (1884), pp. 265–71 (6 figs.).

Angular Aperture Question, Robert B. Tolles and the : Annual Address of the President, JACOB D. COX.
Proc. Am. Soc. Mic., 1884, pp. 5–39 (4 figs.).

Aphides, Embryology of (EMANUEL WITLACZIL, *Zeitschr. für Wiss. Zool.*): G. MACLOSKIE.
Am. Nat., XIX. (1885), pp. 172–6 (3 figs.).

Bacteria, Staining, for Microphotographic Purposes : EDGAR THURSTON.
Eng. Mech., XL. (1884), pp. 335–6.

Bacteria, Chromogene.
Am. Mon. Mic. Jour., V. (1884), pp. 224–6.

Blastopore in the Newt (*Triton cristatus*), On the fate of the : ALICE JOHNSON. *Quar. Jour. Mic. Sci.*, XXIV. (1884), pp. 659–72 (17 figs.).

Blood, Morphology of Rheumatic : E. CUTTER.
Proc. Am. Soc. Mic., 1884, pp. 194–8 (11 figs.).

Camera Lucida, Schröder's.
Am. Mon. Mic. Jour., V. (1884), p. 221.

"Chicken Gapes," The Parasite in : DR. WALKER.
The Microscope, IV. (1884), pp. 271–2.

Cholera Bacillus, The.—Koch's reply to his critics.
Science, IV. (1884), pp. 554–5.

Choano-Flagellata, S. K., New Members of the Order. See Infusorial Order.

Cholera Microbe, The. *Am. Mon. Mic. Jour.*, V. (1884), p. 238.

Circulation, The Extra-Vascular : J. REDDING.
Proc. Am. Soc. Mic., 1884, pp. 81–90.

Comma Bacterium, Dr. Koch and the : E. RAY LANKESTER.
Nature, XXXI. (1884), pp. 168–71 (6 figs.).

Copepod of the Clam, On a parasitic : R. RAMSAY WRIGHT.
Am. Nat., XIX. (1885), pp. 118–24 (10 figs.).

Culture-tubes for Micro-Organisms.
Am. Mon. Mic. Jour., VI. (1885), pp. 1–2 (2 figs.).

Diatoms—*Eupodiscus*, Researches on the Structure of the Cell-walls of : J. H. L. FLÖGEL. *Jour. Roy. Mic. Soc*, IV. (1884), pp. 851–2 (1 fig.).

Diatom Valves, The Structure of the : R. P. H. DURKEE.
Proc. Am. Soc. Mic., 1884, pp. 105–9 (3 figs.).

Diatom Valves, Broken, On some Photographs of, taken by Lamplight : J. D. COX. *Jour. Roy. Mic. Soc.*, IV. (1884), pp. 853–8.

Diatomaceæ, Mounting the.
The Microscope, IV. (1884), p. 280.

Difflugia globulosa, Duj., Copulation of : CARL F. JICKELI.
Am. Mon. Mic. Jour., VI. (1885), pp. 15–16.

Eggs of Mottled Umber Moth (*Hybernia defoliaria*); under heading Graphic Microscopy: E. T. D.
Sci.-Gossip, 1884, p. 265 (colored plate).

Elektrischen Glüh-und-Bogen-Licht, Ueber einige Versuche mit: MAX FLESCH.
Zeitschr. für Wiss. Mik., I. (1884), pp. 561–3.

Embryology, Outlines of (1. Introduction).
The Microscope, V. (1885), pp. 15–20 (5 figs.).

Endomersions-Objective: LEOPOLD DIPPEL.
Zeitschr. für Wiss. Mik., I. (1884), pp. 485–90 (2 figs.).

Erineum anomalum (Mite Gall), found on the Black Walnut, A Botanical Study of the: LILLIE J. MARTIN. (A. A. A. S., Phila., 1884.)
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Eupodiscus. See Diatoms.

Eyes of Some Invertebrata: JUSTUS CANIÈRE.
Quar. Jour. Mic. Sci., XXIV. (1884), pp. 673–81 (4 figs.).

Eylaïs extendens (?) (The Red Water-Mite); under heading Graphic Microscopy: E. T. D.
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Fungi Found in Sewage Effluents: A. W. BENNETT.
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Fungus (*Milowia nivea*), Description and Life-History of a New: G. MASSEE.
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Graphiology, Microscopic: J. E. WYTHE.
Quek. Jour, II. (1884), pp. 86–90.

Hair: Microscopically Examined and Medico-Legally Considered: WILLIAM J. LEWIS.
Proc. Am. Soc. Mic., 1884, pp. 59–70 (22 figs.).

Halisarca lobularis, The Development of: W. J. SOLLAS.
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Hybernia defoliaria. See Eggs of Mottled Umber Moth.

Infusoria, Observations on, with Descriptions of New Species: D. S. KELLICOTT. *Proc. Am. Soc. Mic.*, 1884, pp. 110–25 (11 figs.).

Infusoria, Rotatoria, etc.; Notes: D. S. KELLICOTT.
Proc. Am. Soc. Mic., 1884, pp. 126–30.

Infusoria from Fresh Water, Some apparently undescribed: ALFRED C. STOKES. *Am Nat.*, XIX. (1885), pp. 18–27 (8 figs.).

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Am. Mon. Mic. Jour., V. (1884), pp. 226–30 (10 figs.).

Infusorial Order Choano-Flagellata, S. K., New Members of the: Alfred C. Stokes.
Am. Mon. Mic. Jour., VI. (1885), pp. 8–12 (7 figs.).

Infusorial Life, Indestructible: Jabez Hogg.
Eng. Mech., XL. (1885), p. 406, and p. 430.

Infusorial Teratology, A Little: Alfred C. Stokes.
The Microscope, V. (1885), pp. 7–11 (10 figs.).

Live-Cell for Observation with the Microscope, Description of a Convenient Form of: G. M. Giles. *Sci.-Gossip*, 1885, pp. 7–9 (2 figs.).

Meteorites, Microscopic. *Am. Mon. Mic. Jour.*, VI. (1885), pp. 16–17.

Micro-Organisms, Culture-tubes for. See Culture-tubes.

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Microtome, An Inexpensive. *Sci.-Gossip*, 1885, pp. 7–9 (2 figs.).

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Science, IV. (1884), pp 540–1 (1 fig.).

Microscope-Objectives and Lenses, The Magnifying Power of: W. H. Bulloch. *Proc. Am. Soc. Mic.*, 1884, pp. 183–5.

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Milowia nivea. See Fungus.

Mite Gall. See *Erineum anomalum.*

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Proc. Am. Soc. Mic., 1884, pp. 209–11.

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Newt (*Triton cristatus*). See Blastopore, and Primitive Streak.

Objectives, An Improvement in: E. Gundlach.
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Objectives, Testing, Considerations in: E. Bausch.
The Microscope, V. (1885), pp. 1–5.

Oculars, Report of the Committee on.
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MISCELLANEA.

EARLIEST OBSERVATION OF MULTIPLE IMAGES.—The earliest observer of the phenomenon of microscopic multiple images, was Leeuwenhoek (1632–1723), the Father of Scientific Microscopy. He used the cornea of the eye of the Dragon-fly. 'When I removed,' said he, 'the tunica cornea a little from the focus of the microscope, and placed a lighted candle at a small distance in front, I saw some hundreds of wonderfully minute inverted images of the flame of the candle, and these so distinctly that I could discover the motion or trembling in each of them. Directing my view through the same tunica cornea to the steeple of our new church, I saw the representation of a great number of minute steeples, inverted, and they seemed no larger than the point of a needle seen by the naked eye.'

The compound microscope, of course, by inverting these inversions, shows the images erect. Leeuwenhoek's observations and discoveries were all made with the simple microscope.

EYES OF TABANUS.—Every microscopist has noted the geometrical symmetry of the beaded lines formed by the corneules of the compound eyes of insects. To this law of graceful arrangement the eyes of *Tabanus* furnish no exception, notwithstanding the division of the cornea into two distinct regions by the line of demarcation which undulates across it. In the specimen which, examined in its natural state, by reflected light, guides this description, the facets below the common boundary of the two districts have about one-half the diameter of those above it. The observer would naturally expect to see twice as many vertical, or nearly vertical, rows below as above; to find the upper rows in line with only alternate lower ones ; and to discover the rest of the lower ones intercalated between their more honored fellows.[1] Owing, however, to obliqueness of direction, the rows of the smaller facets appear of the same number with those of the larger, and continuous with them. This appearance is purchased at the cost of a considerable bending of the beaded lines from their direct course, where they cross the boundary ; still, the deflection does not, either mathematically or to the eye, destroy the general symmetry.

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[1] Such intercalations do, indeed, occur ; but only sparingly. In the specimen examined, only three have been observed.

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ADDRESS OF THE PRESIDENT, MR. CORNELIUS VAN BRUNT, DELIVERED AT THE ANNUAL RECEPTION, FEBRUARY 6TH, 1885.

The members of the New-York Microscopical Society have invited their friends to be present this evening, not for the purpose of listening to an address, but that they may see the interesting and beautiful objects for exhibition under the microscope.

Every branch of microscopical research is so full of interest that no justice can be done in any one direction in an address of this character. I will, therefore, confine my remarks to the improvements made in the microscope itself, and to those subjects of research that are now receiving the most attention.

In regard to the instrument : many improvements have been made in the stand, in methods of swinging the understage and mirror, and in adapting the binocular ;—and many of the most recent stands are models of beauty and good workmanship. But, as a whole, the advance has not been as marked in this direction, as in the making of lenses for high magnifying power. A few years since, the only lenses employed were what are termed dry lenses ; that is, an objective brought down close to the object under examination, by means of the rack and pinion, and used without any intervening medium but the air, as an ordinary hand-lens is used.

With the higher powers, especially, the passage of the rays of light obliquely from the object, through the glass cover, then through the air, and into the lens of the objective, produces a distortion,—as a tea-spoon is apparently distorted by immersion in a glass of water,—the ray being bent by passing from a substance of one refractive index to that of another.

The first improvement was the use of water as the medium between the glass-cover of the object, and the glass of the objective, instead of air. This arrangement produced a lens of better definition ; and many new forms were seen, and many other forms were better seen than ever before.

Yet a still further advance was made, when a medium homogeneous with the glass, was used, or of the same refractive and dispersive index as glass, instead of water ; and the lenses that give the best definition and show minute objects the clearest are those called "homogeneous-immersion objectives." These lenses, however, with the highest powers in use, are not at all suited to a public exhibition—every motion being magnified as well as the object ; and the delicate adjustments necessary to keep this object in focus. preclude the use of such lenses, except in a very quiet place.

It is often asked, "What are the limits of the powers of a microscope? Have they been reached by opticians?" From our present standpoint, with the known difficulty of grinding small lenses, also with the difficulty of using them satisfactorily, it would not seem possible to go much further in this direction. But we know too little of the forces in this universe, usable by man, to form a correct judgment.

The delicacy of the human ear was not conceived of, until the telephone demonstrated that the ear can hear and appreciate vibrations inappreciable by the most delicate instrument ; and that acoustic vibrations can be transformed into electrical, and back again, until there is, virtually, no limit to the use of the ear but the imperfection of insulation.

In a letter published a few days since, Mr. Thomas A. Edison states that there could be no difficulty in talking over a wire stretched to the moon, and that over the treeless and dry plains of the West, it is as easy to hear one thousand miles as a few miles in a crowded city.

In the same way, the delicacy of the human eye is not yet appreciated. Prof. Rood, some years since, by a very ingenious mechanical method,—described in the "American Journal of Science,"—demonstrated that the eye is capable of seeing with a flash of light lasting the fifty-millionth part of a second.

We have, so far, only used the refractive powers of translucent substances—as glass—to see minute things ; but the future may give us, by other means, a method of seeing—as we now have a method of hearing—infinitely preferable to the one in present use.

A little reflection in regard to the space in which we live, will show us how ignorant we are of the surroundings of our existence ; and how inconceivable are the facts—those things that we know to be facts—around us. We cannot conceive of any atom so small that it cannot be divided, or of any extension of space so great that it has no bounds ; and it is between these infinities that we live, and are trying to push each way into the unknown ;—by the telescope and mathematics into the vast distances outside of this globe, and by the microscope among the minute forms of life, toward the constitution of matter.

Of the constitution of matter, we learn only indirectly. We are all familiar with the molecular and atomic theory. Although it is a theory, something like it must be true ; for there is a subdivision that will, if continued, separate all compound substances into their original elements, the atoms of which are smaller than the molecules—such as water into hydrogen and oxygen. Beyond this, it is quite as much a mystery as the outside confines of space.

One thing is evident,—the constitution of matter appears to be adapted to beings of about our size. Many inconveniences would attend a man one-sixteenth of an inch high ; every drop of water would be a mountain, and no existence, such as we now have, would be possible. An expansion, instead of reduction, would be equally undesirable, as a moment's thought must show. Still, microscopically, we are far away from either molecules or atoms ; for, according to Sir William Thomson's researches on thin films, a molecule of water must bear the same ratio to a drop the size of a pea, as an orange to a globe the size of the earth.

The question is often asked, "How much will the best microscope magnify ?" Now, it is not a question of magnifying, at all. It is, "How much can we see when we do magnify ?" The commonest lens of one-inch focus, can make a picture of an object—either on a screen or to be viewed by an eye-piece—of two or three thousand diameters ; but the whole picture will be so imperfect and obscure, that no detail can be seen ; and the eye can see much better when the magnifying power is only sixty or seventy diameters.

So, in regard to the best homogeneous-immersion lenses, the limit of clear vision is five or six thousand diameters. Therefore, the possibility of seeing a molecule by a lens that would require two hundred and fifty million diameters, is rather remote.

In regard to the objects shown by the microscope here this evening: the magnifying powers range from twenty, to five or six hundred diameters; the Bacillus may require a lens magnifying about one thousand diameters.

So much for the microscope as an instrument of research; and although, as before remarked, if we ever see a molecule, it will be by some other method than refraction, we do have before us, shown by the microscope as it now exists, a world of life and beauty, unseen by the unassisted eye. The objects to be seen this evening are from many different fields of research, and it will not be out of place to refer to them, although a short description is appended to each form, in the list of objects distributed. We have eight microscopes showing entomological objects,—insects and parts of insects,—all of which are interesting. The use of the lenses of the compound eye of the beetle (No. 3), and of the mosquito (No. 16), for the purpose of showing multiple images, is worth attention from those who have never seen this curious experiment. The bouquet of butterfly-scales is a very artistic arrangement of minute forms. The *Tingis hyalina* (No. 32) is a very black and objectionable insect in a very nice dress. We have nineteen microscopes devoted to botanical specimens; sections, pollen, diatoms, desmids,—all worth looking at,—four of which are living forms; and two of these (Nos. 39 and 44) show the curious movements of the protoplasm in the cells of living plants. Seven microscopes are devoted to minerals, among which the crystallization of gold in fern-like shapes is one of the most beautiful; three to polarization of salts; two to living infusoria; one to embryology; two to electric light; two to Bacilli; the rest to different subjects, among which I would particularly refer to the ciliary action upon the gills of an oyster (No. 10). After looking through this microscope, anyone can be fully aware of the immense amount of vitality that is taken into the stomach with every raw oyster.

Although some of the subjects of research are not of immediate practical value, many of them are, and from further investigation much can be expected.

Much time and effort have been devoted to the first forms of life. As the theory of evolution derives the higher forms from the lower, and as examples of intermediate stages are present with us, it has been thought that creation is going on all the time, and that it can be shown that forms of life are developed in water, without any previous life for their origin. This, however, is not shown to be true. Indeed, the results of all the experiments so far, show that no life with which we are acquainted, is brought into existence without a previously existing germ, that may be invisible.

One of the first forms of life is "protoplasm." It is the "living portion" of the plant, that which is sensitive, which moves, and which appropriates the food ; and in it lies the principle that makes the plant grow.

This is always in constant motion, under the proper conditions of heat and moisture, and is shown under Microscopes Nos. 39 and 44.

There are but few characteristics which distinguish between vegetable and animal protoplasm. Everything, animal and vegetable, begins in a "speck of jelly ;" and this jelly-speck in its simplest animal form, the Amœba, is found everywhere in water, and has been seen by every microscopist.

Grant Allen, in a recent publication, describes it as follows : "In these minute and very simple animals there is absolutely no division of labor between part and part ; every bit of the jelly-like mass is alike head and foot and mouth and stomach. The jelly-speck has no permanent limbs, but it keeps putting forth vague arms and legs every now and then from one side or the other ; and with these temporary and ever-dissolving members it crawls along merrily through its tiny drop of stagnant water. If two of the legs or arms happen to knock up casually against one another, they coalesce at once, just like two drops of water on a window-pane, or two strings of treacle slowly spreading along the surface of a plate. When the jelly-speck meets any edible thing—a bit of dead plant, a wee creature like itself, a microscopic egg—it proceeds to fold its own substance slimily around it, making, as it were, a temporary mouth for the purpose of swallowing it, and a temporary stomach for the purpose of quietly digesting and assimilating it afterward. Thus what at one moment is a foot, may at the next moment become a mouth, and at the moment after that again a rudimentary stomach. The animal has no skin and no body, no outside and no inside, no distinction of parts or members, no individuality, no identity.

Roll it up into one with another of its kind, and it couldn't tell you itself a minute afterward which of the two it had really been a minute before."

I will also refer to another subject that has received much attention. Many years since, peculiar forms of life had been found with decomposing animal and vegetable matter. Many forms are described by Ehrenberg, as Vibrio, Bacterium, etc. They are now named Micrococcus, Bacterium, Bacillus, Vibrio, Spirillum, and they are simple granules, duplicate cells, rods and spiral filaments, nearly all possessing the power of motion, usually by flagella,—or vibrating hairs,—and can be seen satisfactorily only by the best lenses. It remained for Professor Tyndall to show that no decomposition can take place without this life; and that solutions of materials that are ready for decomposition will not be changed if placed in an atmosphere of perfectly pure air. Further investigation has shown that characteristic forms of minute life accompany disease; and we have not only *Bacillus tuberculosis* of Consumption (No. 34), and Cholera Bacillus (No. 35), but a host of other Bacilli.

The question that interests us is, Do these forms produce disease, or do they only accompany the disease as their product? Every house-wife knows quite as well as Prof. Tyndall, that perishable substances can be kept in a jar for a long time without change, by hermetically sealing the jar at the temperature of boiling water. But the workers with the microscope have found the reason why: and that is, that these forms of Bacilli and Bacteria that always accompany decomposition, are necessary to it; that they are mostly destroyed by heat at the temperature of boiling water; and that the germs of these forms are everywhere present in ordinary air, and no decomposition takes place if such air be excluded after the destruction of these forms. Very naturally it is inferred that the Bacteria produce the decomposition, and also that the Bacilli of Cholera, Tuberculosis, etc., produce these diseases.

These are yet open questions. Much of the life-history of these forms has been learned, many experiments have been made, and the literature of the subject is becoming large. Although inoculation with some forms has produced disease, there is a great diversity of opinion in regard to this matter; and many more experiments are needed to decide this momentous question.

The objects shown here this evening do not exactly represent the work of the Society. That is shown by the papers read during the year, and by the discussions at our regular meetings

This Society is organized for the purpose of increasing our knowledge on every subject in the investigation of which a microscope can be used. Our knowledge is limited. We have, as individuals, and collectively, obtained but a glimpse of this great universe ; and in that part of the universe revealed by the microscope, we have nearly everything yet to learn.

Slowly, year after year, the microscope has improved. Year after year, a little has been added to the general stock of knowledge, each acquisition only showing us how vast is the unknown yet to become known. We have, however, the beginning. In each direction a little has been accomplished, and it is for combined effort and work that our Society has been formed. I am proud of the work that has been done during the past year. Many new facts have been learned ; many interesting discussions about known facts have taken place, and many papers have been read that are worthy of preservation Also excellent exhibitions of objects under the microscope have been given at every meeting. In short, our Society has been a "success" in every way, and we would desire our friends to enjoy it with us.

In the pursuit of Microscopy there is a keen enjoyment—an enjoyment, of which the ignorant can form no conception—an enjoyment that goes through life to the end.

THE LIFE OF AN OYSTER.

BY PROF. SAMUEL LOCKWOOD, PH.D.

(*Delivered February 20th*, 1885.)

LADIES AND GENTLEMEN:

The time was when it was enough to say of a living thing, that it lived. You remember the Fool's question in King Lear,—

"Canst tell how an oyster makes his shell?"

This was simply a proverb of old. Here was a little creature, a mere clot of animate jelly, capable of building for itself a house of stone. How it did it, who could tell? No one. The Fool's question was a puzzle to the wisest. Indeed, then, and long after, it was hardly safe to seem to know too much. To-day, however, the question may be put, not only how does the oyster make its shell, but also how does the egg make the oyster? Science, now, can describe the building of the house, and can narrate the life-history of the builder and occupant.

Two years ago I lectured in this place on the oyster. I desire that my address to-night shall be wholly distinct from that one. Yet, as my lecture-notes are always very brief, it is easy to forget what was said so long ago; hence I shall trust to your charity, should I unwittingly at some point repeat myself. I recollect that the longest part of that lecture was devoted to the physiology of the oyster—that the three vegetal systems were discussed at length; namely, the nutritive, or food system; the circulatory, or blood system; and the respiratory, or breathing system. The nerve system was also considered in detail. Now, my desire when coming here was to make no reference to any of these four sets of functions. But I have been requested to dwell a little upon the nutritive, or digestive group of functions; and this I am glad to do, because it will enable me to speak of an organ, the use of which was not known at the date of my former lecture.

You will remember that I had some large carefully drawn diagrams. The fear of repeating myself induced me not to bring them; hence you will please follow my rude illustrations on the blackboard. I will now with the crayon outline an oyster shell. This is the right valve, the one from which the mollusk is eaten when taken on the half-shell. This large spot which I make is the adductor muscle, with which the creature pulls together its shells. It is the part which is cut through with the knife when the caterer opens the bivalve. Well to the left of this I draw four plates, or leaves, so lying on one another as to show their outer edges, which give the appearance of a frill. This series of plates constitutes the gills, or breathing apparatus. Now, here we find the inner edges of these four plates to be, so to speak, soldered together, making the base of the gills; and along this base, in rows, is a series of holes. The plates are really composed of an infinite series of microscopic tubes, each tube being like a tiny flute with holes on the side. The water enters between the plates, and as the surface of the tiny tubes is covered with cilia, or fleshy hairs, these keep up a lashing by which the water is driven through the gill-tubes, and the air contained in the water is deprived of its oxygen; after which the disaërated fluid passes out at the holes in the bases of the gills. The coarse cilia, or beard, on the edges of the mantle, or thin film which enwraps the oyster, by their action make an eddy at the opened valves, into which the water rushes, bringing in the food. The outer surface of the gills is covered with the minute cilia, all helping to drive the inflowing current upward. Here at the uppermost end of the oyster, near the hinge, are four little plates, not lying upon one another, as the gill-plates do, but standing together, as it were. These are the labia, or lips of the oyster; for, in fact, the creature's mouth is simply the orifice between these two pairs of lips. When the food-laden water reaches this spot, the lips begin a sorting process, by which that which is fit for food is allowed to enter, and the unfit is rejected. The oral aperture is almost immediately over the stomach, the passage being too short to be properly called a gullet, or œsophagus. Yet the word is convenient. Thus the stomach receives the food immediately. The dark gray mass in which this organ is imbedded, is the liver. The oyster's stomach is, literally, inside of its liver. Let us now note the course of the intestinal tract. Beginning at the lower end of the stomach, or where in our own structure would be the pylorus, the intestine runs to a point considerably beyond the middle of the adductor muscle, between that and the gill bases. Here it doubles upon itself. Then, returning, it passes through the liver to a point near the oral cavity, or mouth, which it sweeps nearly over; and, winding round the liver on its other side, and then going beneath that organ, it passes beyond to the other side of the adductor muscle, in front of which the vent rests in an open space which we will call the cloaca. Here it voids its indigesta, which are immediately committed to the sea.

The liver, as you know, is bitter, a quality which the Roman epicures prized highly. But we must dwell here a minute longer, to describe the remarkable services which this large organ renders to the stomach of the oyster.

But, first, a word as to the oyster's food. A part is composed of infusoria, often called animalcules, little creatures invisible to our unaided eyes. These are easily digested. This is probably true also of the sporules of algæ, and even the unicellular algæ themselves. It is not true, however, of a large part of the oyster's food, such as the minute copepods, tiny crustaceans with limy shells; and the swarms of diatoms, very minute plants with siliceous shields, which even resist the action of nitric acid. An oyster's stomach is of itself a helpless affair. It has no triturating surface, or secretors of solvent acid. But it draws all it needs, from the liver. In the walls of the stomach are openings continuous into small tubes in the renal mass. Here are the bile secretions, and those of the pancreas; also the salivary glands, and the gastric follicles. We see, therefore, why the stomach is placed inside the liver,—that organ is really the laboratory of the necessary dissolvents of the oyster's food.

Now it may be that one important ingredient which is contained most richly in gastric juice, is supplied but feebly, if at all, from this renal source. You who like tripe hardly need be told that it is not strong food, but is of easy digestion, because of the pepsin it contains, derived from the gastric follicles of the bovine stomach. The action of pepsin is probably that of a ferment, while that of the other substances mentioned may be chemical and mechanical. Lately the microscope has given a hint in this direction, and a hint to the scientist is sometimes a Godsend leading to a discovery. Here you see a little organ, like a tiny white thread of vermicelli. It lies almost parallel to the intestines, and one end of it penetrates into the stomach, at its lower end. This is called the crystalline style, or rod ; and a notable fact is that under the microscope it does not reveal the slightest cell structure, as a tiny morsel taken from the oyster anywhere else certainly would. What I mean is that the substance of this style is homogeneous, as if it were made of simple gelatine. Now for the hint to which I have alluded. The part, or end, which is inside the stomach, like the end of a stick of candy in the baby's mouth, is abraded, or melted away in part. The surprising fact, then, is the almost perfect certainty that this organ supplies pepsin to the oyster's stomach—a conclusion which has only been reached within a few days past, from the study of this organ in other mollusks.

But you observed the extraordinary length of the intestine—nearly three times that of the oyster's body. Now, as the food is lashed along by the numberless cilia inside the intestine through its entire length, and as the nourishing juices are taken through the walls by osmosis, you see that this arrangement subjects the entire food-supply to a thorough absorption. But the length is not all the wisdom in this digestive scheme. The intestine is not a simple cylinder. A cross section shows a convolute inner wall ; it is as if a small cylinder were soldered by one side along the inside of the large cylinder along its whole length, thus increasing immensely the absorbing surface.

You may think it wonderful that the oyster should grow so fast upon such minute food. I have lately been compelled to study this matter up. Some months ago a live sea-horse was brought to me. Her scientific name is *Hippocampus heptagonus*, but we named her Hippie. It has been a joy to me to have kept her in good condition so long. But it has required some management. The fisherman who brought it was asked how it should be fed. "Oh," said he, "it is n't a fish, and so don't feed, but lives on suction." He spake wiser than he knew, as this singular fish does live entirely on microscopic life. I will tell you my secret—how I managed the matter. I gave her an aquarium to herself, and kept two large jars for breeding animalcules ; that is, infusoria, &c. But these invisible things need nitrogen, and an aquarium should be absolutely clean. The problem seemed to be, how to have it clean and dirty at the same time. Now, if you drop into your aquarium a bit of fresh beef, and let it be until, like the peddler's fish, it has become a little mellow, it will generate nitrogen, and that will quicken the breeding of infusoria. When, by microscopical examination, I find that this food-supply is getting low, I transfer Hippie to one of the large jars ; and, if that gives out, I place her in the other jar. By this time the larder at home is resupplied, and the little creature is restored to her proper place.

So far we have got along without much technical discourse. As I must note the leading kinds, or species, of oysters, we must resort to a few scientific names. In the extreme South there is a long narrow oyster called the strap oyster, and, by the negroes, coon-heel. In southern New Jersey, in the mouth of the Delaware, on the crowded beds, the oysters, for want of room, will grow standing on their heads ; hence they elongate. These are known as stickups. But these and some other forms are but variations of our common oyster along the entire eastern coast-line, and are all one species known as *Ostrea Virginiana.* Europe has three species. The one common to England and France, and some other places on the Continent, is *O. edulis.* On reaching Italy we find the little oyster known as *O. plicatula.* You have heard of that greediest Roman of them all, that imperial gourmand Vitellius, who ate a thousand oysters at a sitting, and who, after having the royal fauces tickled with a feather by a slave, would disburden his stomach, then fill it afresh. Perhaps the transaction was possible with the little *Plicatula.* But what about such specimens as the *Virginiana*, which Mr. Thackeray was invited to grapple with in Fulton Market ? Three individuals filled his plate. Said an English lady to whom he was relating his experience : "Why, Mr. Thackeray, what were your feelings ?" "Well, I felt, in attacking but one of them, that it was like trying to swallow a baby." A thousand "Virginias" would have been trying to the vitals of Vitellius. The fourth oyster to be mentioned is the one whose original home seems to be the Tagus, in Portugal. This species is *Ostrea angulata.* It is said to be the one whose shells were used in the ostracism, or vote of banishment, in ancient Greece.

The four species mentioned are all that have any place in commerce. The oyster native to France, Northern Europe, and England, is the *O. edulis.* This species, and the Italian, *O. plicatula*, are hermaphrodite, or bisexual, while the Portuguese, *O. angulata*, and the American, *O. Virginiana*, are unisexual.

In these species, as among the fishes, there is a true spawning of eggs by the female, and a fecundating of them in the water which has been fertilized by the presence of the male. But with *O. edulis*, and *O. plicatula*, there is no spawning of eggs at all. The eggs are retained between the lobes of the animal, and there hatched, and when emitted into the water, are already well advanced, each having a pair of perfectly formed shells.

The English oyster, *O. edulis*, is capable of producing a million and a half of spawn in a season. But it is shown to a demonstration that our American bivalve, *O. Virginiana*, can produce in one season, that is, in the r-less months, from twenty, to twenty and a half millions of spawn. But these are simply eggs, and do not get the start of the spawn which is emitted already hatched. However, I do think that there is some relation between our American push, and our physical environment. It is a characteristic of the country. An insect ordinarily well-behaved on the other side of the ocean, so multiplies, if it but immigrate here, as to become a pest and a defiance.

How does the oyster make his shell? At a recent meeting of the American Association for the Advancement of Science, a paper was read asserting that the extreme age of an oyster is twenty years. Now I had previously, in an article in the Popular Science Monthly, demonstrated that an oyster might be in fair edible condition at the age of thirty years. Here are the shells of one of the oysters on the characters of which the statement was based. This double shell is thirty years old, and the enclosed mollusk was large, and in fair condition. But of this specimen, more anon. In building its shell the oyster starts with the hinge end, at the spot known to conchologists as the *umbo.* A small plate, or single scale, now represents each valve, and that is the first season's growth. The next season a new growth, or plate, shoots out from underneath the first one, just as shingles do. The oystermen call these laps, or plates, "shoots," and they claim that the number of shoots indicates the years of the oyster. They certainly do contain a record of the seasons, showing the slow-growing and the fast-growing seasons. But there is often great difficulty in clearly differentiating these shoots. The record is often obliterated in places by the growth of parasites, which build their shells or tubes upon the oyster. I have likened these shoots to shingles. Now, at the gable of a house these shingles may be seen edgewise. So on the side of an oyster-shell is a series of lines. This is the edgewise view of the shoots, or season-growths. Another factor is this purple spot, or scar, in the interior of the shell. It is the place of attachment of the adductor muscle. Its first place of attachment was close up to the hinge. Had it stayed there until the shell had become adult, how difficult would be the task of pulling the valves together! the leverage to be overcome would be so great; for we must bear in mind the fact that at the hinge end the valves are held by this black ligament, which is, in life, elastic, swelling when the shell opens, and being compressed when the animal draws the valves together. So, with every year's growth, or elongation of the shell, the mollusk moves the place of attachment of the muscle onward, that is, an advance farther from the hinge. As it does so, it covers up with white nacre all the scars that are back of the one in actual use as the point of attachment of the muscle. This you can prove by eating off with nitric acid this covering, and thus exposing the whole life-series of scars, or attachments.

I have likened the oyster's shoots, or season-growths, to the shingles on a roof. To make the similitude complete, it would be necessary for the bottom shingle on the roof to underlie the whole series, and reach even to the roof-tree, or ridge-pole. Then the second shingle from the gutter must in like manner underlie all the rest of the series; so of the third; and so on with the rest. In this way lie the shoots, or laps, of the oyster's shell. The last one deposited underlies them all, and every one terminates at the channel in the bill—so that this groove in the bill contains a series of transverse lines, each one marking a season, or year. Thus we get really four factors for the solution of the question, "How old is the oyster?" all of which are the outcome of the method or way of making the shell.

Now for the story of the shell in my hand. This, with another, was given me by an intelligent oyster-raiser at Keyport, N. J., with the question, "How old are they?" My answer was: "About thirty years." Said he: "You have hit it. In 1855 I planted a bed of oysters on a clean sandy bottom. But they did not do well. Oysters want, at least, a little mud. The next year we took them up for the market; but they were poor. So we dredged the bed, and did not plant there again. This year

I thought we would examine that bottom, and, to my surprise, we took up these two oysters, which evidently were left of that planting thirty years ago. I opened them, and they proved to be of fair quality." Does not this agreement between the naturalist and the oysterman deserve to be called a demonstration?

How does the oyster begin life? I shall now speak only of the American oyster, whose earliest babyhood is so different from that of the English mollusk—since theirs is emitted in an advanced stage of development, while ours is emitted simply as an egg. In the r-less months, our oyster-beds are, many of them, marked by the appearance of little clouds of a milky hue. These proceed from the female oyster, which snaps its shell, and thus emits its spawn into the water. The male, in like way, emits the fecundating milt; but, to the eye, this is invisible. The eggs, sinking to the bottom, fall in with some of the milt in the water, and the spermatoza at once attach themselves to them. As seen under the microscope, the tiny egg becomes like a bur; that is, as if it were beset on the surface with cilia. In a word, it is fecundated, and with this addition of life it mounts up from its bed and floats away. In two or three hours the egg is hatched, and the development of the little creature begins. At first, it is a little triangular thing. It now begins to swim actively. But how does it do it? From what we might call the base of the angle which outlines the little thing, you see a pad projecting. Really it is a brush of cilia, every individual of which is lashing its way with the force of a projectile. In a very few hours a spot appears on each side of the apex of the triangle. Each spot is the beginning of a shell, or valve; and the fact of its beginning where it does, at what we have already called the umbo, has caused Dr. John Ryder to name this the umbo stage of the oyster's life. Nature in her work with an egg seems to delight in developing toward a side. In this way she starts a fish, a reptile, a bird, and a mammal. But our "midget" oyster is perfectly symmetrical—each valve, or side, is the exact counterpart of the other.

This roving life of the embryo oyster exposes it to infinite perils. It is certain that of the twenty or thirty millions of eggs emitted, not more than an average of two or three individuals will attain a size fit for the market. If all were to survive, such would be the growth of oyster-beds that coastwise navigation must cease. But the waste is simply enormous—so many are the enemies and so various the perils of the infant mollusk. To devise wise methods of artificial culture is now the great problem on which the scientific men of the U. S. Fish Commission are at work. That done, we may hope for some arrest of this stupendous waste.

I suppose our young oyster to have stopped his roving life. He has made an attachment, wise or unwise. And strange attachments he does sometimes form. I have in my collection quite a display of eccentric, if not discreditable ostrean alliances. I have one oyster which is hugging desperately a ring-bolt, another devotedly attached to a decanter, and, again, no less than half a dozen ardently attached to a whiskey bottle. Whatever may be the object chosen,—and anything will do that serves as an anchorage,—the mollusk, if not disturbed, stays there for the rest of its natural life.

Let us suppose our little oyster now attached to its object. It is yet the merest atomy of life—a microscopic object—and, it is likely, not much over a day old. But in that atom, and during that time, how rapidly the life forces have worked ! The little thing now puts all its powers at house building. First, it lays the foundation by placing itself on its left side, in order that the hollow, or dish-shaped valve, may be cemented to its anchorage. There is now a secreting and exuding of a horny substance, of a mucilaginous consistency, which is called concholine. This is laid down on the rock, or other support, in a meshy form, just like a tiny wad of the finest conceivable lace. Into these meshes percolates the carbonate of lime held in solution by the sea water. In this way is the foundation laid. Next, there is a spreading out of the shells on asymmetrical lines—for the valves are becoming inequal and dissimilar. But during this foundation work, what about food-getting ? Perhaps we shall see.

One of the first serious studies of my young days, in Zoology, was the question, What becomes of the tadpole's tail ? I carried a tadpole into froghood. He had ceased to be a gill-breather, and, having lungs, must emerge from the water, and come to the air. Nor could he any longer live on carrion and putrid plants. He must now hunt the living insects. Such a change is hardly less than a shock. I observed that my frog kept still, but bearing his tail behind him, which, of course, was the proper place, if he must carry it at all. Now it was just this "at all" which perplexed me. The books said that the tadpole's tail is lost by atrophy—that is, that it dries off. Nonsense! Nature does not entail such a waste of the raw material. I watched the frog day by day, and discovered that the caudal annex was being absorbed. It was getting shorter, but the shortening was going on at the thick, or proximal end. Now, so it was—every particle of that appendage was taken in. This done, the animal had to forage for subsistence. And similarly is it with our baby oyster while laying the foundation, and shaping its house. That prominent organ, the swimming pad, is getting absorbed—for it is now its food-supply. It is now developing internally, for as yet there is but little more than the beginning of things. The intestine is simply a short, straight organ, and is not yet convolute. But the liver is very large; in fact, it quite preponderates.

And what of Ostrea's life? Who are her friends? There is a pretty red branching sponge, which often grows upon the oyster, *Microciona prolifera.* Formerly it was very common. It is less so now. This sponge often serves the oyster well, in buoying the bivalve up when sinking in the mud. It is also in its way a grove in which the infusoria breed, and so supply food to the mollusk. The oyster, too, has a gay "commensal." I like this pretty old word of Chaucer, meaning one who dines at our table, and is welcome there. Of course, all this precludes the idea of a parasite. This gay little commensal is a red and white crab hardly larger than a pea. It lives literally in the oyster, ensconced between the folds of the mantle—but it does not live upon its host. Between them both there seems to be a good understanding. It is the female *Pinnotheres ostreum.* Experienced oystermen have told me that it is rarely found except with oysters in good condition. The curious fact is that it is only the female *Pinnotheres* that lives in the oyster. The male is often seen floating on the surface of the water, with a pretty white anchor on his jacket, the gay little sailor that he is. His general hue is brown. He has a harder shell than the female, whose shell is thin and transparent. The truth is that, though twice as large as the male, she is very tender, and her coddling life as a commensal, is a necessity. The red sponge I have mentioned is called by the oystermen "red-beard." There is another object that delights to grow upon the oyster, which they call "gray-beard," and sometimes "gray-moss." It is one of the Bryozoa. The one that I have often found is *Sertularia argentea*, an exquisite creature ; for, though looking like a delicate silvery alga, it is not a plant at all, but a finely branching Zoophyte, or community of exquisite living animal florets. This serves the oyster well, in much the same way as does the red sponge.

But our oyster has many enemies. The boring yellow sponge, *Cliona sulphurea*, eats very minute holes into the shell, so numerous, and so winding, as in some instances to cause the shell to fall in pieces. These minute holes, under the microscope, show gouges at their edges, as if they had been cut with chisels, like post holes. But the process is as yet a mystery. The great winkles, *Sycotypus canaliculatus* and *Fulgur carica*, with their file-tongues will rasp off the nib end of the oyster shell, then introduce the sucking siphon, and so consume the mollusk at their leisure. The little drill, *Urosalpinx cinerea*, is a severe pest. This shell and the two just mentioned are spiral univalves. The drill is a small shell rarely measuring three-fourths of an inch in length, and its lingual ribbon, or file-tongue with its armature of several rows of sharp teeth, is microscopic. I have watched it at work, and I think that the little burglar bores a hole through the oyster's house by crooking its tongue, as I do my finger, letting the knuckle represent the bend, or crook of the file-tongue, in which case the teeth would stand out like a brush ; which brush twisted around and back again, in a three-quarter or perhaps entire circle, would represent the action of a drill. The hole is always perfectly symmetrical, and generally is countersunk at the place of starting. The hole completed, the tiny siphon tube of the mollusk is introduced, and the soft parts of the oyster are taken up. Sometimes the drum, *Pogonias chromis*, inflicts severe damage on an oyster-bed. This singular fish has in the upper part of its throat very large, and solid, pharyngeal bones, which are covered with closely set hard round pavement-teeth, not unlike the cobble-stones of old. With its front teeth it picks up an oyster, and it crushes it with the pharyngeal teeth, and then swallows it. This fearful creature gets its name from a booming noise which it is able to make. One year a school of drums entered Raritan Bay, and destroyed many thousands of dollars' worth of oysters in a single night. Excepting man himself, the worst enemy of the oyster is the five-finger, or sea-star, *Asterias arenicola.* A sea-star is an object with five rays, and is of the consistence of soft leather. If we turn it over we observe a canal along each ray, or finger, through its entire length. On each side of this canal is a row of ambulacra, or little feet, each with a sucking disc at its extremity. At the centre, or base, of the rays is the oral cavity, in which is the stomach sack, which is capable of being everted and protruded. It is a blind sack, but its walls will, by osmosis, take up food. With these five rays, and their thousands of little suckers, it will grasp an oyster ; and, waiting until the mollusk opens, be it never so little, it will thrust in its everted stomach, and suck out the oyster's life. I have not demonstrated the point, but my belief is that the sea-star has some urticating power, and even paralyzes its victim. To the oyster-raiser, the star is often a calamity. Many thousands of bushels are sometimes taken by it in a season from the beds. Other enemies there are, but time is wanted to speak of them.

I must say a word on the pearl. Though not the pearl oyster, our mollusk is a pearl maker. Nacre, or mother of pearl, constitutes, to a greater or less extent, the shells of all oysters. But the isolated individual pearl, that which is accounted a gem, and the worthy decoration of a bride, is always an enforced product. It is made upon occasion of inconvenience, suffering, or disease. It was a pretty coincidence this morning, that, having just finished thinking out the brief for this address, I looked into Shakespeare, and alighted on that expression of Touchstone : "Rich honesty dwells like a miser in a poorhouse, as your pearl in your foul oyster." It is surely interesting that this wisdom of the poet, drawn from the proverbial lore of the people, finds its verification in science. The pearl is the outcome of suffering. It is elaborated in distress. So delicate, so mild, so exquisite. It is already perfect—the one only gem that does not ask the lapidary's skill. And how many a precious thought, having passed through the alembic of suffering, has crystallized into a living form, a thought-pearl of purity, etherial and immaculate !

And now, my friends, if our discourse has enabled us to know better one of God's lowly little creatures, we have done well, since it will help us to love the creator more.

PROCEEDINGS.

MEETING OF FEBRUARY 6TH, 1885.—THE ANNUAL RECEPTION.

The first meeting of the Society in February is the Annual Reception. At this meeting the regular order of business is suspended, the President whose term of office has expired, delivers an Address, the newly elected officers assume their duties, and an exhibition of microscopic objects is given for the entertainment of the Society's guests.

On the evening of February 6th, 1885, the Society gave its seventh Annual Reception. For the accommodation and gratification of its guests, the auditorium, with side-room, of Lyric Hall, at No. 723 Sixth Avenue, and the services of Mr. C. W. Stub and his orchestra, had been engaged for this occasion. The President, in his Address, reviewed briefly the recent improvements in the construction of microscope-stands and objectives, and presented some thoughts on the capabilities of the instrument and on certain parts of its field of work. The Address is published in full in this number of the JOURNAL.

At the close of the Address, the doors of the side-room were thrown open. In this room had been arranged sixteen round tables, and on each were three microscopes with their objects. The list of objects, with their linear magnification and the names of their respective exhibitors, is given below.

1. *LIQUID-CAVITY IN A RUBY.* × 50.
   Exhibited by G. F. KUNZ.
2. *MICROSCOPIC CRYSTALS OF GARNET.* × 25.
   Exhibited by G. F. KUNZ.
3. *MULTIPLE IMAGES OF THE WORDS,* **THE SUN**, *FORMED BY EYE OF BEETLE.* × 400.
   Exhibited by F. W. LEGGETT.
4. *RADIAL LONGITUDINAL SECTION OF TAMARACK* (*Larix Americana*), *SHOWING MEDULLARY RAYS.* × 550.
   Exhibited by P. H. DUDLEY.
5. *THE CUCKOO-BEE* (*Chrysis*); *MOUNTED ENTIRE, IN GLYCERINE.* × 20.
   Exhibited by the REV. J. L. ZABRISKIE.
6. *FLOWER OF CLAYTONIA VIRGINICA.* × 25.
   Exhibited by F. COLLINGWOOD.

7. *THUIDIUM; A MOSS: SHOWN BY POLARIZED LIGHT.* × 50.
Exhibited by W. G. De Witt.

8. *FOOT OF SPIDER.* × 75.
Exhibited by W. G. De Witt.

9. *POLLEN OF PERIWINKLE* (*Vinca rosea*). × 250.
Exhibited by E. A. Schultze.

10. *CILIARY MOTION IN THE OYSTER.* × 65.
Exhibited by F. W. Devoe.

11. *BRANCHIAL CIRCULATION IN EMBRYONIC AXOLOTL.* × 20.
Exhibited by F. W. Devoe.

12. *TRANSVERSE SECTION OF STEM OF PEPPER-PLANT.* × 30.
Exhibited by E. C. Bogert.

13. *INFUSORIA, FROM INFUSION OF HAY.* × 400.
Exhibited by F. Y. Clark, M. D.

14. *GOLD AND TIN FOIL: SHOWN BY ELECTRIC LIGHT.* × 25.
Exhibited by F. Y. Clark, M. D.

15. *ARRANGED DIATOMS.* × 40.
Exhibited by F. B. Green.

16. *MULTIPLE IMAGES OF A ROTATING* ★, *FORMED BY EYE OF MOSQUITO.* × 800.
Exhibited by J. D. Hyatt.

17. *TRANSVERSE SECTION OF STEM OF SERJANIA, A SOUTH AMERICAN VINE.* × 50.
Exhibited by C. F. Cox.

18. *TRANSVERSE SECTION OF INFANT'S TONGUE.* × 90.
Exhibited by Horace W. Calef.

19. *ELECTRICAL RAIN—ELECTRIC SPARKS FROM AN INDUCTION COIL.* × 70.
Exhibited by Edward G. Day.

20. *HEAD OF TIGER-BEETLE.* × 30.
Exhibited by Edward G. Day.

21. *SECTIONS OF HUMAN HAIR, SHOWING THE PIGMENT IN THE CELLS.* × 1,200.
Exhibited by M. M. Le Brun.

22. *ARBORESCENT CRYSTALS OF OXALURATE OF AMMONIA.* × 70.
Exhibited by C. W. McAllister.

23. *BOUQUET OF BUTTERFLY-SCALES.* × 30.
Exhibited by C. W. McAllister.

24. *JAWS AND TONGUE OF WASP.* × 30.
Exhibited by M. H. Eisner.

25. *ARACHNOIDISCUS EHRENBERGII, IN SITU ON ALGA.* × 50.
Exhibited by W. Wales.

26. *ISTHMIA NERVOSA, IN SITU ON ALGA.* × 50.
Exhibited by W. Wales.

27. *MICRASTERIAS AMERICANA; A DESMID.* × 175.
Exhibited by A. D. Balen.

28. *FERN-LEAF GOLD CRYSTALS.* × 30.
Exhibited by G. S. Woolman.

29. *CRYSTALS OF KINATE OF QUINIA, SHOWN BY POLARIZED LIGHT.* × 50.
Exhibited by G. S. Woolman.

30. *PARAMECIUM BURSARIA; A CILIATED INFUSORIAN.* × 125.
Exhibited by A. D. Balen.

31. *SECTION OF TWIN PEARL.* × 30.
Exhibited by H. M. Dickinson.

32. *TINGIS HYALINA; AN INSECT OF THE ORDER HEMIPTERA.* × 20.
Exhibited by H. M. Dickinson.

33. *STELLATE HAIRS ON LEAF OF BUCKTHORN.* × 50.
Exhibited by M. M. Le Brun.

34. *BACILLUS TUBERCULOSIS.* × 1,050.
Exhibited by L. Schöney. M. D.

35. *COMMA-BACILLUS OF CHOLERA.* × 450.
Exhibited by L. Schöney, M. D.

36. *RUBY COPPER, FROM CORNWALL, ENGLAND.* × 30.
Exhibited by W. H. Bates, M. D.

37. *ARRANGED DIATOMS.* × 50.
Exhibited by C. Van Brunt.

38. *POLYCYSTINA.* × 30.
Exhibited by C. Van Brunt.

39. *CYCLOSIS IN NITELLA.* × 100.
Exhibited by W. R. Mitchell.

40 *VERTICAL SECTION OF CONVOLUTION OF HUMAN CEREBELLUM.* × 30.
Exhibited by S. A. Briggs.

41. *SECTION OF DERBYSHIRE COAL, SHOWING CONIFEROUS STRUCTURE.* × 55.
Exhibited by S. A. Briggs.

42. *CRYSTALS OF SALICINE: SHOWN BY POLARIZED LIGHT.* × 25.
Exhibited by Gen. Wager Swayne.

43. *SPIROGYRA.* × 50.
Exhibited by Walter H. Mead.

44. *CYCLOSIS IN ANACHARIS.* × 450.
Exhibited by Walter H. Mead.

45. *GOLD SAND, FROM CALIFORNIA.* × 45.
Exhibited by J. Warnock.

46. *POLLEN OF MORNING GLORY* (*Ipomœa purpurea*). × 55.
Exhibited by J. L. Wall.

47. *CIRCULATION OF BLOOD IN THE FROG.* × 50.
Exhibited by J. L. Wall.

48. *PERISTOME OF THE MOSS BARTRAMIA POMIFORMIS.* × 37.
Exhibited by B. Braman.

Meeting of February 20th, 1885.

The President, Mr. C. Van Brunt, in the chair.

Sixty-seven persons present.

Prof. Samuel Lockwood, Ph.D., addressed the Society, at their request, on the Life of the Oyster.

At the close of the Address, the President stated that the members of the Society, with their friends, had been cordially invited to meet Prof. Lockwood socially, immediately after the adjournment, at the residence of Mr. Devoe.

Prof. Lockwood's Address is published in full in this number of the Journal.

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MISCELLANEA.

Royal Microscopical Society, Annual Meeting, February 11th, 1885: Extracts from Report in *English Mechanic*.—Dr. Maddox exhibited some specimens of Dr. Miguel's improved nutritive lichenised paper for the registration and cultivation of atmospheric and other bacteria, and gave the following particulars of the method used to color the organisms after incubation. The sterilised nutritive paper charged with the lichen jelly is, after use, placed in the incubator for the cultivation of the microbes. It is afterwards put into a saturated solution of alum for five minutes, then washed, and placed in a bath of sulphate of indigo (two grammes to one litre of water) for thirty seconds, again washed, and put into a bath of permanganate of potash (two grammes to 1,000 of water), for thirty to sixty seconds. The paper, now of a rose color, is washed, and immersed for half a minute in a three *per cent.* solution of oxalic acid, by which the paper becomes bleached, while the organisms are shown of a very distinctly blue color.

In the Report of the Council was included the following item: The Council have voted five pounds five shillings to the memorial now being raised in America to the late R. B. Tolles, one of the earliest to appreciate, not merely the theoretical, but the practical, bearing of the immersion system in allowing of the increase of the aperture of an objective beyond that of a dry objective of 180 degrees, which it was so long supposed to be impossible to exceed.

The President addressed the Society on the subject of the life-history of a sceptic organism hitherto unrecorded. The following is an abstract:—

Commencing with a review of the position of bacteria and monads in biology, Dr. Dallinger went on to remark that whoever had studied the same field of septic bacteria for a week or a fortnight without change of conditions would know the strange complexity of relations that are seen to arise, and until this complexity of relations in common forms was understood assured progress was impossible. How the bacteria are inter-related, how far they are mutable and under what conditions, and whether functional changes are as readily, or more readily, induced than morphological changes visibly perceptible, were questions of the highest moment awaiting solution. The forms which give rise to specific diseases were now being vigorously and almost exclusively studied, to the detriment of investigation into forms not connected with disease, from which, however, they must have arisen at some past time. The discovery alleged to have been made by Hans Büchner in 1880, of the convertibility of the bacillus of the terrible disease anthrax, or splenic fever of cattle, into the innocuous *Bacillus subtilis* which it outwardly resembles, and the converse, appears so startling to even a Darwinian, that there must be error somewhere ; for if the law of actual variation, with all that is involved in survival of the fittest, could be so readily brought into complete operation, and yield so pronounced a result, where would be the stability of the organic world ? There could be no permanence in anything living. Dr. Dallinger agreed with Dr. Klein in considering Büchner's so-called results utterly improbable. It was of the utmost importance, however, to discover the true relations between such organisms, and the effect of changed conditions. Whether the changes produced by Pasteur in his attenuated virus were true biological changes, or a mere physical and accompanying chemical attenuation consequent on enfeebled nutrition or extended dilution of some element of the virus, and consequently not involving permanent change, was still unsettled ; but Dr. Dallinger inclined to the latter view. The new organism referred to above first came under notice about four years ago in an exhausted maceration of cod-fish which had decomposed in a broth extracted from the boiling of rabbits, long kept at a temperature of 90° to 95° Fahr. By a complex and ingenious arrangement, not only was the drop of fluid under examination, but also the vapor surrounding it, kept at a necessary constant temperature not varying more than one-tenth of a degree Fahrenheit, and thus its form and movements were fully ascertained. The sub-oval body, lens-shaped, destitute of internal organs, measured about the $\frac{1}{10000}$ in. in length, by the $\frac{1}{19500}$ in. in breadth ; but it had no fewer than six long thread-like flagella, or motile organs, like whip-lashes, each three times as long as the body. One very remarkable mode of locomotion resulting was comparable only to wave-like leaps, reminding the observer of the movements of a shoal of porpoises. The organism was never attached, but by a free darting down upon and away from minute particles of decomposing matter, by large numbers, the matter was in half an hour visibly reduced in size. "No sight accessible to the human eye," said Dr. Dallinger, "can be more fascinating or more beautiful than this. A field of 50 or even 100 may be observed with ease pursuing their untiring work. It is the more entrancing that it is apparently rhythmic, not like the measured march of a regiment, but the rhythmic movement of a peal of bells." The analysis of this movement and its results was most difficult because of the incessant change of position of the organisms. The mode of ordinary multiplication by fission also presented features of great interest, owing to the problem of the formation of the new and numerous flagella. For a long period it was found impossible to observe any sexual form of multiplication ; but unwearied diligence at last succeeded after three years' work. A kind of fusion of two individuals occurred, one of the individuals gradually contracting its flagella, losing its characteristic shape, and becoming ultimately absorbed in the other, which all the while, strange to say, continued swimming with full vigor. After complete union had taken place, the movement was much slower, and the body broke up rapidly into very minute portions, in the course of from four to five hours, the motion of the whole organism being still active. Then, as it swam, it was seen to be dropping from it a stream of granules, the spores, and these being continuously watched, were seen to grow up into the likeness of the parent form, and shortly after to multiply by the old process of fission. Thus, should drying of the fluid take place, a multitudinous supply of the minutest germs, able to resist high temperatures, would become disseminated in the atmosphere, each capable of reproducing the whole series of changes.

Dr. Carpenter, C. B., said that the pleasing duty had been assigned to him of moving a vote of thanks to their excellent and highly esteemed President for the very admirable and interesting address to which they had just listened. He began, as they were aware, by giving them a summary of the doctrines of Abiogenesis and Biogenesis ; but there was one omission in his remarks, due, no doubt, to his modesty, but which ought not to be omitted, and that was that there was no class of facts which had contributed so much to the settlement of some of these important questions as the researches which their President himself had made. They would, no doubt, remember that the great supporter of Abiogenesis, Dr. Bastian, relied upon the appearance of organisms in flasks which had been exposed to high temperatures ; but Dr. Dallinger had shown that though the organisms might be destroyed, the spores could still exist under these conditions. He quite agreed that the two sides of the question—pathogenic and morphological—should be studied separately, and that the observations in the latter case should be carried out in the way adopted by the President by isolating and keeping the object continuously under observation until its whole life-history had been ascertained ; but the pathogenic aspect was also of great importance, and must be worked out with similar care. Dr. Roberts, of Manchester, who was not only a very careful observer, but also a man of very large experience in diseases, wrote a paper some time ago entirely on Darwinian lines, and he there took some very striking examples, such as the production of the bitter almond from the sweet almond, the one being perfectly wholesome, but the other containing a powerful poison. He had himself always maintained that in the study of species it was necessary to study the intermediate forms as well as the complete forms, and had carried this out with great advantage in the case of the orbitolites thirty years ago. Just so he believed the study of the intermediate forms of disease to be necessary. A short time ago he wrote a paper bearing on this subject in the *Nineteenth Century*, and since then he had received a great number of letters in which many instances had been adduced showing that there had been intermediate stages of disease. He desired most heartily to congratulate the Society and also the President upon the admirable and successful work which he had described to them, and upon the completeness of the life-history which he had been able to give them as the results of work, moreover, which extended over a period of four years. As was well known, he (Dr. Carpenter) had always spoken strongly of the value of thorough and continuous work on one subject. There was a great deal of good microscopical power running to waste, for the simple reason that the owners of the instruments gave themselves up to a kind of dilettante study, instead of concentrating their attention. Their President had shown them what was the value of close continuous work, and no better encouragement could be given to the younger members of the Society than was afforded by such an excellent example. He had, therefore, great pleasure in moving that the best thanks of the Society be given to the President for his admirable address.

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THE CELL-STRUCTURE OF PINUS STROBUS.

BY P. H. DUDLEY, C. E.

(*Read March 6th*, 1885.)

Pinus Strobus, or White Pine, is one of our most valuable coniferous trees. Its wood from different localities presents variations in structure, hardness, density, and strength ; and, as observers are not fully agreed as to all of its features, any description of its structure can only be considered as a contribution to the mass of facts yet to be collected to give us the information desired.

Under the microscope, transverse sections and radial longitudinal sections from the duramen usually show two classes of tracheïdes, one of thin and the other of thick walls. Tracheïdes of the former class occupy the inner portion of the annular ring, and contain a part of the resin canals : those of the latter class are in the outer portion of the ring. The cells of the outer three to five rows are more flattened than the others ; and their tangential surfaces contain the lenticular cavities, which are smaller than those of the thin-walled cells ; and the openings in their domes seem oblong. Openings of the same description in the thin-walled tracheïdes are round or elliptical.

On the periphery of the annular ring are found the occasional cells, which, when young, contain starch.

Recent examinations of the conifers show a greater differentiation of the tissues than was formerly supposed to exist. The larger the proportion of the thick-walled to the thin-walled tracheïdes, the greater, within certain limits, is the density, hardness, and strength of the wood. I have here two pieces of selected clear lumber, the best the market affords, and you will be surprised to see the difference in their appearance. In one block, —marked *A*,— the annular rings number eighteen or nineteen per inch, each of which has from thirty-five to forty rows of tracheïdes, chiefly quadrangular. The maximum size of the thin-walled cells ranges from seventy-three by sixty-six micromillimetres, to ninety by eighty-three ; and the thickness of the walls ranges from two and one-half to three and one-half micromillimetres. The maximum dimensions of the thick-walled cells are from fifty-three by forty micromillimetres, to fifty-six by forty-three, and the thickness of the wall ranges from six to eight micromillimetres. There is, moreover, a regular increase in the thickness of the walls, from the interior to within four or five rows of the exterior part of the ring. The thick-walled tracheïdes form but a small portion of the ring, the resin canals are not numerous, and the wood is soft, light, clear, easily worked, and is desirable for pattern making.

In the second block,—marked *B*,—the annular rings number seven or eight per inch, and each ring contains from sixty-five to seventy rows of hexagonal tracheïdes of about the same size with those of block *A*. But the thick-walled tracheïdes form a larger portion of the ring than in block *A ;* the resin canals are more numerous ; and the wood is harder, heavier, streaked, and more difficult to work.

I have another block,—marked *C*,—which is a specimen of the merchantable lumber grown in the vicinity of New York. Its wood differs from that of blocks *A* and *B* in having a sharp line of demarcation between the thin-walled and the thick-walled tracheïdes, the latter being nearly solid,—resembling *Pinus australis*,—the wood very hard, heavy, knotty, difficult to work, and liable to warp badly. The rings of *Pinus australis* have about equal shares of the two classes of tracheïdes, and the difference in strength between the two classes is great.

I brought another piece of wood, sculptured into a model representing, on a scale of five hundred diameters, the general construction of a thin-walled tracheïde. The outer lamella between adjacent cells is supposed to be removed. In transverse section these cells appear as quadrangular, pentagonal, or hexagonal : my model shows the hexagonal form. One side is carved so as to represent the general appearance of a tracheïde in a radial section. The rounded places, which show the domes in the cell-wall and their canals connecting with the lumen, are more numerous at the ends than at the central portion of the tracheïde. The construction of the bordered pits which these domes form is very interesting, and I hope to make it plain by some models. The statement in the text-books, that, when the pits are forming, they have at first a septum which in a short time breaks away and leaves a free communication, needs modification. Here are two blocks, models, marked *D* and *E*, representing, on a scale of four thousand diameters, tangential sections respectively of the thin-walled and the thick-walled tracheïdes. In the latter, especially those which are nearly closed, the septum, generally thickened centrally, will be found intact, as shown by block *E*. In the thin walls, the septum will be found lying against the dome, and is sometimes very difficult to distinguish ; and, often, it is removed in cutting the specimen.

The cells of the medullary system are uniseriate,—except those which enclose a resin canal,—and are of two classes, marginal and central. The former have, by some, been called tracheïdes ; but in American species they do not merit that classification. Small lenticular cavities with septum are visible. The communications between these cells and the upright tracheïdes are delicate and interesting. For we see round portions of the wall projecting inward, forming little domes with central opening and projecting orifice ; then, under each dome, a septum ; then funnel-shaped openings extending to the lumen. All these appear in transverse section as delicate, lenticular cavities.

The central cells of the medullary system are quite different. Their walls are more or less irregular, their ends curved, their openings large ; and in transverse section these walls apparently project into the lumen of the upright tracheïdes, the limiting lamella only not being perforated. This is not the case with all the conifers.

Our tracheïde model illustrates yet other points. You see these transverse indentations, and these openings. The former show the position of the central rays of the medullary tract. Sometimes there are only two rays, sometimes four, eight, or nine : no regularity in the number has been found. The openings show the form of the communications into the lumen. The small openings at each side of the large central openings, belong to the marginal rays of the medullary tract. The ends of the tracheïde are rounded, pointed, and, when directly in contact with the medullary tract, sometimes straight.

In the tangential section, the sides of the tracheïde are somewhat undulating, and, as the overlapping of each row of adjacent cells occurs chiefly in the plane of a radial section, the ends of a tracheïde taper gradually towards a point.

The upright resin canals connect with those of the medullary tract.

LIMITATION OF THE VISUAL FIELD OF THE WORKER HONEY-BEE'S OCELLI.

BY THE REV. J. L. ZABRISKIE.

(*Read March 6th*, 1885.)

The Honey-bee is a remarkably hairy insect. On the head the hairs are dense, and of various lengths; and they cover every part, even the compound eyes and the mandibles. The antennæ, however, are apparently smooth, having only microscopic hairs; and a path through the long hairs, from each ocellus, or simple eye, directly outward,—to be described more fully presently,—is practically smooth.

The ocelli are so situated that when the bee is at rest and the face vertical, they are directly on the top of the head, arranged as an equilateral triangle, and one ocellus is directed to the front, one to the right side, and one to the left.

Long, branching hairs on the crown of the head stand thick like a miniature forest, so that an ocellus is scarcely discernible except from a particular point of view; and then the observer remarks an opening through the hairs,—a cleared pathway, as it were, in such forest,—and notes that the ocellus, looking like a glittering globe half immersed in the substance of the head, lies at the inner end of the path. The opening connected with the front ocellus expands forward from it like a funnel, with an angle of about fifteen degrees. The side ocelli have paths more narrow, but opening more vertically; so that the two together command a field which, though hedged in anteriorly and posteriorly, embraces, in a plane transverse, of course, to the axis of the insect's body, an arc of nearly one hundred and eighty degrees.

These paths through the hairs appear to me to be indications that the ocelli are intended for distant vision, although the opinion that near vision is their function is held by eminent opticians.

The ocelli are nearly hemispherical, and the diameter of each is about fifteen times that of a facet of the compound eye. Such a form of lens would, I will concede, indicate for these organs a short focus, and, hence, a fitness for near vision.

But if the ocelli are intended for near objects, it is difficult to understand why they are surrounded by a growth of hair so dense as to permit unobstructed vision only in a very narrow field, and why they are so placed on the top of the head as to be debarred from seeing any objects in the neighborhood of the mandibles and the proboscis, the ability to see which objects would appear to be very necessary in the constant and delicate labors of the worker Honey-bee among the flowers.

A CATERPILLAR FUNGUS FROM NEW ZEALAND, AND SOME RELATED SPECIES OF THE UNITED STATES.

BY THE REV. J. L. ZABRISKIE.

(*Read March 20th*, 1885.)

Of the objects which I have the pleasure of exhibiting this evening, the main one is a larva, probably of some large moth, infested with a fungus of peculiar growth. It was loaned to me for the present occasion by its owner, the Rev. Dr. Baldwin, formerly a missionary at Foo Chow, China, but now pastor of the M. E. Church at Nyack, N. Y. It was presented to him as a curiosity by a scientific friend, who had received it from the chorister of the cathedral at Auckland, New Zealand. The larva is nearly two and one-half inches long. It has become changed to a hard, woody mass, the effect of the drying up of the mycelium of the fungus. Of the fungus itself there were originally two long processes, issuing from the top and back of the head of the larva, where it articulates with the first segment of the trunk (See Fig. 1). Unfortunately, one of these processes is gone; but the other is here, although broken. These are the stems of the inflorescence, intended to bear the fruit, or spores, in an enlarging mass at the summit. From the stem which is here present, the fruiting head has been lost. The part which remains is hard, dry, and brittle, and has been curled in its growth. It is also, at one point, abruptly and irregularly enlarged. If straightened, it would measure about three and one-half inches in length. These stems are reported as sometimes growing much longer.

I do not know the species of this specimen, there being no head or spores to determine it. But there can be no reasonable doubt that it belongs to the genus *Torrubia*, of which the older genus *Cordyceps* is now held to be a synonym; and it is, probably, either *Torrubia Sinclairii* or *Torrubia Robertsii*, both which species are reported as found in New Zealand.

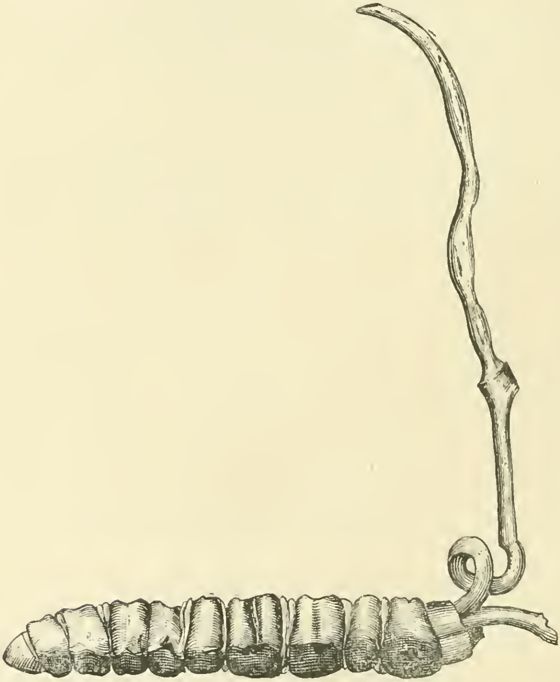


Fig. 1.—New-Zealand Caterpillar Fungus (original).

The classification given in Cooke's "Hand-Book of the British Fungi," places the genus *Torrubia* in the second division, or Sporidiifera,—the fungi which have the spores in asci, or sacs,—and in the sixth, or last family, the Ascomycetes, or genuine sac-bearers. It is entered as the first genus of the Sphæriacei, of which *Sphæria*, or the simple sphere with sacs, is the type. The fruit of the genus *Torrubia* is compound, consisting of a number of perithecia combined in a globular or elongated head. It will be observed that this specimen stands among the highest orders of the fungi.

Two dozen or more species of *Torrubia* have been described as found in different countries. These fungi are the friends of man, because they assist him in the contest with injurious insects. Of the several species which, fortunately, occur in our own country, perhaps one of the most common and most widely distributed is the *Torrubia Ravenelii*, Berk. It is described by Prof. C. V. Riley in the "American Entomologist," Vol. III. (Old Series), 1880. It infests the "White Grub," which is the large, fleshy, brown-headed larva of the *Lachnosterna fusca*, or June-beetle—a larva well-known to farmers and gardeners for its destructive habits. It feeds principally on the roots of plants, especially of young corn, of various grasses, and of the strawberry. The *Torrubia Ravenelii*, when developed in this larva, fills its body; and it sends out, invariably from the lower side of the head, near the base of the mandibles, two, sometimes four, fruiting stems, to a length of five or more inches. The infested larva is under ground, and the fruiting stems grow upward out of the soil and into the air. The length depends, probably, on the quantity of aliment which is at the command of the fungus. In the second and third illustrations, after Riley, which accompany this article, the fruiting stems are abortive (See Figs. 2 and 3). But the next illustration, after Berkeley, exhibits the stems in fruit (See Fig. 4). The stem becomes flexuous, and is surmounted by an elongated conical head. The head is dotted with a multitude of black protruding perithecia, which contain the spore-sacs. Each sac yields many spores. The illustration includes a representation of one of the spores as it appears when highly magnified—very long and slender, and many-jointed. When fully ripe, the spore breaks up at the joints. Each segment is capable of reproducing the fungus.

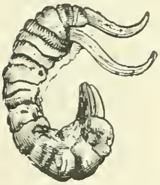


Fig. 2.—White-Grub Fungus (after Riley).

Another species native to this country, and frequently met with, is the *Torrubia militaris*. It infests those pupæ of moths which are concealed just beneath the surface of the ground. The fruiting stem issues usually from the head, but sometimes from the articulations, of the pupa, and it rises in the air to perfect its fruit (See Fig. 5). Commonly there is only one stem from one pupa, but occasionally several are found. The stem, together with its head, is from one to two inches long, and its color is orange-red. The entire surface of the head is thickly studded with the conical immersed perithecia, which contain the sacs and spores. Fig. 5 shows a few of these perithecia *in situ*, magnified seventy diameters, but less crowded relatively than in the object itself. The same figure shows one of the spore-cases from these perithecia. These cases are unusually long and slender, and are filled with the long, thread-like spores, two of which are here figured. The spores are nearly as long as the cases which contain them, and are divided by a multitude of transverse septa into minute joints.

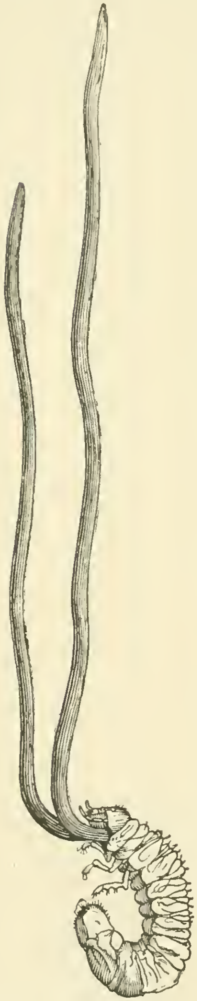


Fig. 3.—White-Grub Fungus (after Riley).

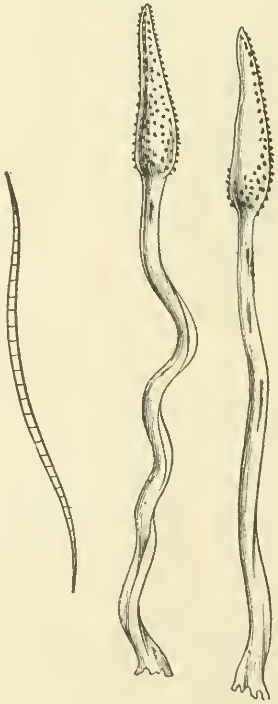


Fig. 4.—Fructification of White-Grub Fungus (after Berkeley.)

Your attention is called to one more native species, the *Torrubia clavulata*, Schw., represented in Fig. 6. It infests the coccus, or scale-insect, of the Black Ash. This coccus is of the genus *Lecanium*. The male is a two-winged creature, which passes through its sportive life in a very short period. But the noticeable member of the family, on account of her endurance, and her attachment to her home, is the female. When very young, she fastens herself to some suitable spot on the ash twig, thrusts her beak into the bark, and lives on the sap of the plant. She now begins to be covered with a shell. This enlarges and hardens into a nearly hemispherical mass firmly attached to the twig and about a quarter of an inch in diameter. Here the insect lives and dies, without ever moving from her selected station. She is frequently affected with the fungus last mentioned,—the *Torrubia clavulata*,—which, as autumn approaches, bursts through various parts of the rounded shell in little fruiting stems about one-tenth of an inch in length. I have collected this fungus on Haight's Island,—an island in the Hudson River, about fifteen miles below Albany,—where it appears to be quite frequent. Sometimes the fruiting stems number from fifteen to nineteen on one insect. Usually the stems are simple, slender,

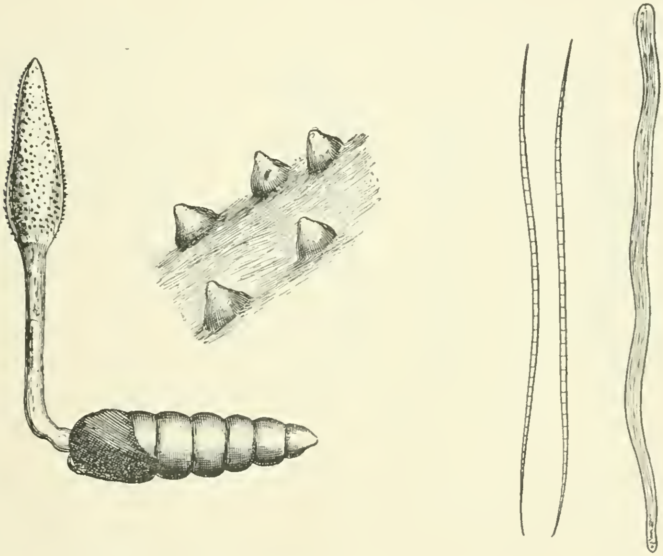


Fig. 5.—Pupa Fungus (original).

and curved; and the head, which is about one-quarter or one-sixth the length of the stem, is black, broadly elliptical, and crowded with the comparatively large, rounded perithecia, thus presenting the appearance of a miniature mulberry. On one specimen the stems were nearly all branched—an unusual occurrence. A stem of this description (shown in Fig. 6) had originally three branches, only one of which is now entire. In this species of *Torrubia*, the spore-cases and the spores are quite slender; still, their forms are much less slender, and the joints much less numerous, than in the other species.

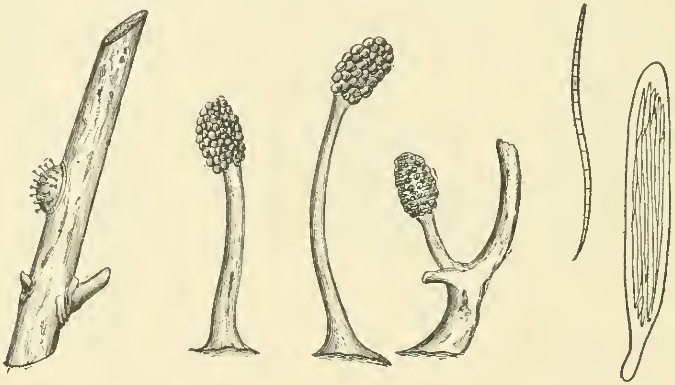


Fig. 6.—Scale-Insect Fungus (original).

Prof. Riley says that Mr. Walsh, in an article published in the "Practical Entomologist" (Vol. II., p. 116) on the fungus which attacks the White Grub, was the first to suggest in this country the practical use of fungi in the farmer's war against insects; and he further says, that "however little faith he may have in the use of beermash or yeast as a general insecticide, as recommended by Dr. Hagen, he is fully convinced that great good may be accomplished in destroying insects injurious to vegetation, by the study and propagation of those particular fungi that are severally known to attack particular species." We may yet live to see the day when the fungi will be used by man as one of the prominent means of exterminating our insect pests.

CHILOMONAS PARAMÆCIUM.

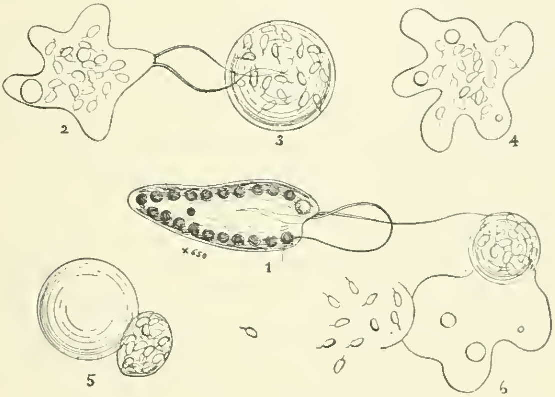
BY SARA GWENDOLEN FOULKE.

(*Received March* 25*th*, 1885.)

Since its discovery by Ehrenberg, this form has been carefully studied by Bütschli, Stein, and Kent, the two latter giving the first entirely accurate diagnosis of its character.

According to Kent, *Chilomonas* is classified as follows : Order, Flagellata-Eustomata ; Family, Chilomonadidæ ; Genus, Chilomonas.

Fig. 1 represents the form so accurately that no detailed description is necessary.



Bütschli states that this animalcule, when isolated for observation, quickly loses its normal contour and becomes spherical, finally disintegrating.

While I was investigating a drop of water teeming with *Chilomonas*, a minute flagellate amœboid form (Fig. 2) entered the field, and after swimming uncertainly about for some moments, settled to the bottom of the live-box, where it moved in amœboid fashion, the two flagella becoming merged in the pseudopodia-like processes. The presence of about twenty small highly refractive bodies, suspected to be germs, was noticed. Soon the mass became so diffused as to form a mere film, and presently disintegrated, setting free these bodies, which swam away. Several similar individuals were found, some of which, on becoming quiescent, took a globular shape, retaining both flagella to the last. This sphere then grew larger and its wall thinner until, like a bubble, it burst, liberating the germs, which were always present, and very active (Fig. 3). So many of these forms were now found, while the number of the adult forms of *Chilomonas* at the same time diminished, that the identity of the two was suspected ; and the suspicion was verified almost immediately by my witnessing the transformation throughout.

An individual would begin to spin round, gradually losing contour, while the refractive "corpuscles" ranged near the cell-wall left their places and moved actively about, showing, as did also the increased transparency of the cell, incipient liquefaction of the endoplasm. An amœboid character was now assumed until, finally, one or the other of the two phases above noted was entered upon. When the final shape was that of Fig. 4, the freeing of the germs was effected in various ways. Sometimes, as stated, the film became generally disintegrated. In other cases, one large external vesicle was formed, leaving only a very small portion of protoplasm enclosing the germs, and from this the germs energetically freed themselves after the bursting of the vesicle (Fig. 5). In still others, a small vesicle formed about the germs and, moving to the cell-wall, extruded itself, and burst, liberating the germs directly into the water, after which, the remainder of the animalcule disintegrated (Fig. 6).

In from four to five days each of these germs developed into an adult *Chilomonas*, having the characteristic form at an early stage of growth. The "corpuscles," or, correctly, the germs, appeared in these at maturity.

The habit of breaking up, as recorded by Bütschli, probably coincides with the above phenomena, and, although that author does not describe the liberation of germs, I believe this habit to exist principally for that purpose, as the young, or recently matured, *Chilomonas* was not affected by confinement. This, then, seems to be the first time that the true character of the ornamental belt of so-called corpuscles has been indicated.

The transition to the globular and the amœboid phases afforded strong corroboration of the opinions of Stein and Kent, as opposed to that of Bütschli, regarding the point of growth of the flagella,—showing them to be inserted close together.

TRACHELIUS OVUM.

BY SARA GWENDOLEN FOULKE.

(*Received March 25th*, 1885.)

In first describing this Infusorian, Ehrenberg attributed to it the possession of a much ramified œsophageal canal, but his view, later upheld by Claparède and Lachmann, has been strongly opposed by W. Saville Kent, who claims that the so-called alimentary canal is merely the granular protoplasm highly vacuolate. My own observations had coincided with those of Mr. Kent, and, recently, strong confirmation of his opinion was obtained from the following phenomena :—

I had taken from a *Chara* bog numbers of *Trachelii.* Their unusually large size—one-fortieth of an inch—afforded special advantages for observation. In color, the specimens were a transparent creamy yellow. When first removed to the live-box, they uniformly showed the ventral side to be flattened and deeply indented longitudinally, so that a transverse section would be kidney-shaped. After a confinement of some minutes, they became globose in contour, and thus they remained during captivity ; but when they were set free, the indentation soon reappeared. In one specimen, the granular reticulation, at first finely shown, seemed to become less profusely ramified, and a current of the protoplasm towards the central mass was noticed. This flow continued until all the smaller branches were massed at a sub-central point, leaving the rest of the body apparently hollow. One pseudopodium-like process was now sent to a more posterior point in the periphery, and the flow was resumed, this time outwards, until the protoplasm was collected into a nodule attached to the cell-wall, along which a small portion flowed, afterwards remaining motionless. No nucleus could be detected in this specimen, though present in all others examined.

The above condition remained unchanged for nearly an hour, when, wishing to test the apparent hollowness of the cell, I removed from the live-box all but a small portion of the water, and pressed the *Trachelius* with a blunt knife-blade. Complete collapse ensued, and the animal now resembled a twisted rag.

It seemed, however, nowise injured by the operation, as, after about six hours passed at the edge of the water, it resumed its globose shape, and free motion about the live-box again began.

An accident prevented further investigation, but, from the diffused condition of the nucleus, incipient reproductive phenomena were suspected.

In this connection I should like to draw attention to a form described by me in a communication to the Academy of Natural Sciences of Philadelphia, March 4th, 1884, under the name of *Trachelius Leidyi.* The distinction then made with regard to shape having been rendered invalid by the observations above noted, color, and the more profuse vacuolation of the periphery, alone remain, and, regarding these as insufficient differences, I have decided to withdraw the species.

PROCEEDINGS.

MEETING OF MARCH 6TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Thirty-eight persons present.

John Butler, M. D., Mr. Lucius Pitkin, Mr. Henry L. Brevoort, and Mr. Max Levy, were elected Active Members of the Society.

OBJECTS EXHIBITED.

1. Sections of *Pinus Strobus :* by P. H DUDLEY.
2. Head of the worker Honey-bee : by J. L. ZABRISKIE.
3. Fossil leaf of *Hausmannia :* by N. L. BRITTON.
4. Transverse section of leaf of *Pinus pungens :* by H. W. CALEF.
5. *Stauroneis phœnicenteron :* by E. A. SCHULTZE.
6. Embryonic Spiders; mounted in glycerine : by F. W. DEVOE.
7. Cholera Bacilli : by W. H. BATES, M. D.
8. Spores of Cholera Bacillus : by L. SCHÖNEY, M. D.
9. *Synapta*, from Bermuda : by W. G. DE WITT.

THE CELL-STRUCTURE OF PINUS STROBUS.

Mr. Dudley exhibited microscopic sections of *Pinus Strobus*, or White Pine, and hand-specimens of three varieties of the wood as determined by differences of fineness and hardness. He described the cell-structure ; and he illustrated his description by photographs, and by three large wooden models which represented severally a tracheide, a lenticular cavity of the thin-walled tracheïdes, and a similar cavity of the thick-walled tracheïdes. His observations form the opening article in this Number of the JOURNAL. Discussion added the following matter :—

Mr. Dudley : "The wood of a tree growing in an exposed situation, has the firmer grain : its fibres are less easily separated by flexure. I believe my specimens, notwithstanding their differences, to belong to one species only."

Dr. Britton : "Only one species of White Pine is found east of the Mississippi, and no marked varieties of it are known to botanists. The fact of its producing wood of different grain under different conditions, has a parallel in the behavior of the *Liriodendron tulipifera*, or Tulip-tree, the wood of which is sometimes nearly white, sometimes quite yellow ; and to woodmen the tree is known accordingly as White Tulip Poplar or Yellow Tulip Poplar. There is reason for referring this difference to diversity of soil."

LIMITATION OF THE VISUAL FIELD OF THE WORKER HONEY-BEE'S OCELLI.

Mr. Zabriskie exhibited the head of the worker Honey-bee for the purpose of directing attention to a peculiar disposition of the abundant hairs surrounding the ocelli, these hairs admitting the light through narrow openings which greatly circumscribe the ocelli's visual field. He thought this arrangement to indicate that the ocelli are intended for distant vision. At the conclusion of his observations,—which are given in full elsewhere in this Number of the JOURNAL,—Mr. Zabriskie added : "Besides the worker Honey-bee, I have brought for exhibition the drone and the queen of the same species, and the queen-cells ; the queen of *Bombus Virginicus*, one of our native Humble-bees ; the *Melissodes binotata*, male and female ; the *Melissodes pruinosa*, both sexes ; the beautiful *Anthophora dispar*, male and female, of Tunis, Africa ; and the celebrated little stingless bee of Abyssinia, the *Trigona Beccarii*, which lives in immense colonies, and stores large quantities of honey. The *Anthophora dispar* has a very long proboscis. The possession of such a proboscis by our own bees, would add millions of dollars annually to the wealth of the United States."

FOSSIL LEAF OF HAUSMANNIA.

Dr. Britton: "My specimens of fossil leaf were taken from the lower cretaceous clays of Middlesex Co., N. J. As these clays are extremely fine and plastic, fossil leaves are remarkably well preserved in them as thin membranaceous sheets of carbonized vegetable tissue, which, when recently collected, show very perfectly all the details of venation. At the suggestion of Prof. Newberry, I have detached and examined a fragment of one of these carbonaceous films, and I find the parenchymatous cell-structure and the stomata plainly discernible. The examination was made on *Hausmannia*, a genus the botanical affinities of which are somewhat uncertain. I may add, that specimens of lignite from the same strata show their woody cell-structure quite clearly, and that those which were examined proved to be coniferous."

CHOLERA BACILLI.

Dr. Bates: "I have two slides. One, prepared by Dr. Koch, shows a pure culture of cholera bacilli. The other, a double slide, is from Paris: one mount contains a pure culture of cholera bacilli; the other, secretions taken from a patient who had died of cholera. The two forms correspond exactly."

SYNAPTA.

Mr. De Witt: "My object, a species of *Synapta*, from Bermuda, is mounted entire. The most noticeable parts are the branched tentacles surrounding the mouth, and the perforated calcareous plates and anchor-shaped spines. The common impression that the spines are locomotive organs is not supported by my observation of the habits of this animal. They serve, instead, for defense, and for attachment to the sea-weed on which the creature is found. The organs of motion are the tentacles."

Mr. Bogert presented to the Society some dried specimens of *Gyrinus natator*.

MEETING OF MARCH 20TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Twenty-four persons present.

The President appointed the Committees for the current Society-year, as follows :—

I. THE STANDING COMMITTEES.

1. On Admissions ; C. S. Shultz, J. Warnock, W. Wales, J. D. Hyatt, J. L. Zabriskie.
2. On Publications ; B. Braman, J. L. Wall, W. H. Mead.

II. THE SPECIAL COMMITTEES.

1. On Entomology, J. D. Hyatt.
2. On Improvements in Microscopes and Microscopical Apparatus, W. Wales.
3. On Medical Science, L. Schöney, M. D.
4. On Mineralogy, A. A. Julien.
5. On Cryptogamic Botany, J. L. Zabriskie.
6. On Phanerogamic Botany, N. L. Britton.
7. On Adulterations, W. H. Bates, M. D.

OBJECTS EXHIBITED.

1. Caterpillar Fungus, from New Zealand : by J. L. ZABRISKIE.
2. Scale-Insect Fungus (*Torrubia clavulata*) : by J. L. ZABRISKIE.
3. Photograph of *Amphipleura pellucida* ; taken by Dr. Van Heurck : by WALTER H. MEAD.
4. Diatoms ; mounted in Prof. H. L. Smith's newest medium : by C. VAN BRUNT.
5. Photographs of Diatoms ; taken by C. Febiger : by C. VAN BRUNT.
6. *Closterium acerosum* : by A. D. BALEN.
7. Eye of *Limulus*, upper surface : by WALTER H. MEAD.
8. Eye of *Limulus*, under surface : by WALTER H. MEAD.
9. Path of Electric Spark ; prepared by Prof. G. M. Hopkins : by C. W. MCALLISTER.
10. Ovoid Concretions on the shell of a hen's egg : by M. M. LE BRUN.

NEW-ZEALAND CATERPILLAR FUNGUS ; AND SCALE-INSECT FUNGUS.

Mr. Zabriskie exhibited, described, and illustrated a fungus, of the genus *Torrubia*, which had pervaded the larva of a large lepidopter, and had developed two fruiting stems ; also, a fungus, the *Torrubia clavulata*, which had destroyed a coccus, of the genus *Lecanium*, and had sent up through the shell of its host several stems of infloresence. He described and illustrated, besides, two other species of *Torrubia* which are parasitic on injurious insects ; and he touched the topic of the service which such fungi might, if their life-history were better known, be made to perform as insecticides. His observations are given in full elsewhere in this Number of the JOURNAL.

PHOTOGRAPH OF AMPHIPLEURA PELLUCIDA.

Mr. Mead : "The photograph of *Amphipleura pellucida* which I have here, was loaned to me for this exhibition by Mr. R. Hitchcock. It shows the dots. It was taken by Dr. Henri Van Heurck, with the use of incandescent light, vertical illuminator, and a $\frac{1}{18}$th-inch Zeiss homogeneous-immersion objective."

The President : "This photograph shows both sets of lines clearly. It was taken, I have been informed, from a silvered frustule."

DIATOMS MOUNTED IN PROF. SMITH'S NEWEST MEDIUM.

President Van Brunt : "Prof. H. L. Smith, as you all know, has made a series of experiments in order to discover the best material for mounting diatoms. He at length found a medium which brought out the markings of diatoms very distinctly, but it did not last well—it would soon cloud or crystallize. As the result of further trial, he now has a medium which, he says, does not crystallize. It is glycerine holding a salt in solution, and has a refractive index of 1.8. I have here a dozen or more slides of diatoms mounted in this material. The markings show quite as well as in any other medium of high refractive index. I do not, however, think that a medium of high index is suitable for any but the most minute and delicate diatoms—diatoms which are not easily seen under the ordinary conditions. The large forms, when mounted in this medium, appear quite dark, and almost opaque:"

PHOTOGRAPHS OF DIATOMS.

President Van Brunt : "I have brought for exhibition a number of photographs of diatoms that were mounted in Prof. Smith's new medium. They were taken by Mr. Febiger, of Wilmington, Del., to whom, for this purpose, I sent my own box of slides.

He uses for this kind of work a Spencer $\frac{1}{15}$th-inch lens. He sent these pictures without expressing an opinion as to the value of the medium. It is important to get a mounting material which will give a good photograph. Balsam has been objected to. The new medium, consisting, as it does, of a salt dissolved in glycerine, has an advantage, since its refractive index can be easily varied by varying the proportion of the ingredients. It has also a disadvantage. It is not dense enough—especially when, through dilution, the index is not higher than 1.5 or 1.7—to hold the diatoms in place : they slide about in all directions, and a photograph of them cannot well be taken. And even when this medium is viscous enough to hold the frustules, the heat of the lamp soon causes them to move. Will Mr. Dudley state his views on this subject ?"

Mr. Dudley : "My experience in photographing diatoms mounted in the new medium, accords with the statement given by the President ; and I have found, in addition, that the slightest particles of dirt, present in the medium, gradually move toward the larger diatoms, and thus mar the picture."

OBSERVATIONS ON RESOLUTION OF AMPHIPLEURA PELLUCIDA.

Mr. Wales : "When, about twenty-five years ago, diatoms began to be studied as test-objects, the lenses, which were then of very low aperture, disclosed in *Pleurosigma angulatum* only one system of lines. Afterwards, lenses of higher angular aperture revealed, besides, the intersecting lines ; and, still later, further increase of resolving power made known the beads, or bosses. This, therefore, is the order : first, the systems of lines; afterwards, the bosses. This law applies to all diatoms that have been fully resolved. It must hold true, as well, of *Amphipleura pellucida.* If, therefore, a lens is incapable of showing the two systems of lines in this diatom, I feel sure that it will not show the beads ; and I am constrained to think that those persons who believe themselves to have seen the beads, with such a lens, have confounded illusive images with real ones. I have myself, as yet, seen, by transmitted light, only one set of the lines. The new medium of Prof. Smith will, perhaps, enable us to resolve both sets. The photograph made by Dr. Van Heurck shows them ; but that was taken with a vertical illuminator."

CLOSTERIUM ACEROSUM.

Mr. Balen exhibited cyclosis in *Closterium acerosum*, using for the purpose a $\frac{1}{12}$th-inch objective.

PATH OF ELECTRIC SPARK.

Mr. McAllister exhibited, under a power of sixty diameters, a slide which showed the course taken by an electric spark in traversing a thin film of soot adherent to the glass. Its path is an irregular net-work of mixed sinuose and zigzag lines. This object is prepared in the following way:—

A slide, after being smoked over a small gas-jet, is placed centrally between the terminals of an induction coil, and at right angles to their direction. The terminals are held about three-eighths of an inch apart. A strong current is required.

The President: "A curious effect is produced by passing repeated charges of electricity from a Holtz machine through two plates of glass, between and in contact with which is a sheet of brass foil. The foil is driven into the glass, and it is retained there permanently."

OVOID CONCRETIONS ON SHELL OF HEN'S EGG.

Mr. Le Brun showed, under a magnification of twenty-five diameters, a compact group, in a single layer, of a hundred or more ovoid calcareous bodies *in situ* on the exterior surface of a piece of the shell of a hen's egg. These bodies are solid, they adhere but slightly to their support and to one another, and their long diameter seldom exceeds one-fortieth of an inch.

The table of dimensions of the spicules of *Heteromeyenia Ryderi* which was prepared by Mr. Hyatt and was published in the February Number of the Journal, page 46, contains a typographical error. Corrected, the table will read as follows:—

DIMENSIONS OF SPICULES OF HETEROMEYENIA RYDERI.

Largest pointed spicules: average length, $\frac{1}{100}$th of an inch.

Grappling-hook spicules: average length, $\frac{2}{1000}$ths of an inch.

Short birotulate spicules: length, from $\frac{1}{1000}$th to $\frac{1\cdot5}{1000}$ths of an inch.

Wheels of short birotulate spicules: average diameter, $\frac{8}{10000}$ths of an inch.

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MISCELLANEA.

THE WORKING SESSION OF THE AMERICAN SOCIETY OF MICROSCOPISTS.—In the course of years of practice, every thoughtful microscopist discovers methods of manipulation, ways of observation, and principles of interpretation, which differ in some respects from such as have, through books and journals, become familiar to all. A meeting at which these discoveries can be made known, their value tested, and their benefit appropriated, can but tend to promote the science of microscopy and thus assure with greater certainty the correctness of the results attained in all departments of microscopical research. The American Society of Microscopists did wisely in organizing a meeting of this character. The Working Session, both at Chicago and at Rochester, proved an exceedingly useful feature of the Annual Meeting. Mr. C. M. Vorce, to whom the direction of the Working Session of the convention to be held at Cleveland next August, has been assigned, has prepared an excellent schedule of work. His task is onerous, commensurately with its importance, and his success must depend, not less on his own acknowledged zeal and ability, than on the prompt and cordial coöperation of experienced microscopists. Every Microscopical Society in the land ought to be represented in this work.

THE ALGO-FUNGAL-LICHEN HYPOTHESIS.—Hypothesis helps investigation, provided it be not followed blindly. Some hypotheses are so romantic, they affect so strongly the fancy of their propounder and his followers, as to warp observation and occasion erroneous deductions. Partly of this character, it seems probable, is Schwendener's theory of the morphology and physiology of lichens. At a recent meeting of the New-York Microscopical Society, Dr. Britton invited attention to the Rev. J. M. Crombie's criticism of this theory in Vol. XXI., No. 135, of the Journal of the Linnean Society (Botany). Schwendener's theory is, 'that the lichen is not a distinct plant, but a colony consisting of hundreds and thousands of individuals, of which, however, only one acts as master, while the others, in perpetual captivity, provide nourishment for themselves and their master; that this master is a fungus of the order Ascomycetes, and that its slaves'—the organisms upon which it is parasitic—'are green algals, which it has caught hold of and forced into its service.' Mr. Crombie gives a series of observations which, he believes, subvert this hypothesis ; for they show that the lichen-hyphæ differ essentially from fungal mycelia both in character and in conduct, and that the lichen-gonidia are equally dissimilar to true algals. He thinks the doctrine of the autonomy, or individuality, of the lichen, fully established.

THE MICROSCOPE IN THE SCHOOL-ROOM.—No person who has not made the trial, can form an adequate conception of the mental quickening occasioned by an exhibition of selected microscopic objects to classes in the school-room. The scales on the butterfly's wing, the hexagonal facets of the compound insect-eye, the transformation, as it were, of seemingly shapeless grains of sand into structures of exquisite beauty, the cyclosis of protoplasm in plant-cells, and the movement of blood-corpuscles in the foot of the frog,—reaching the mind through the eye, make and leave an impression, give an understanding, which books and diagrams are powerless to produce. The microscope, frequently and intelligently used, makes nature pellucid. There ought to be an excellent one under skilful manipulation in every school.

SEPTIC ORGANISMS.—Commenting on the phenomena of self-multiplication exhibited in the life-history of these organisms, Dr. Dallinger says (Journ. Roy. Micr. Soc., Apr., 1885, p. 194) :

"The mystery of all this simplicity of vital movement is deep ; and although we can observe and in accurate manner record the process, its *modus operandi* is far beyond our present grasp.

"One thing is certain,—on this rapid power of self-multiplication depends the entire utility of these organisms, and in this function of self-division it would appear that they have reached the highest point of vital development. Lowly they are—we know of nothing living that is lowlier—but in the processes of vital evolution, amongst the lowly and simple as amongst the highly organized and most complex, we find the perfection of concurrent adaptation.

"One other feature in these minute organisms claims a note. They are subject to no caprice ; after twelve years of close observation I am convinced that the vital processes are as orderly, rigid and immutable as in the most complex organisms. Their life-cycles are as clearly definable as those of a crustacean or a bird. No vital phenomenon not to be found amongst higher and larger organisms, is discoverable here. Only the methods of specific mutation resulting from the secular processes enunciated in the Darwinian law are in operation."

THE WORKING SESSION OF THE AMERICAN SOCIETY OF MICROSCOPISTS.—The Executive Committee of the American Society of Microscopists having appointed me Director of the Working Session of the Society for the meeting to be held at Cleveland, Ohio, next August, I have prepared the following scheme of work for that occasion. The general theory of the plan is to illustrate methods of research in the main, leaving the details, which are merely matters of mechanical execution, to be treated as subsidiary matters, since the available limits of the Working Session are insufficient to cover the whole ground at any one meeting.

SCHEME OF DEMONSTRATIONS.

1. The use of the Micro-Spectroscope, and its applications to original research.
2. The use of the Polariscope in original investigations.
3 Photomicrography, and its applications as an aid to research.
4. The use of the Camera Lucida ; various styles and methods.
5. Micrometry ; illustration of different methods.
6. Cultivating bacteria ; exposition of different methods.
7. Injecting vessels and tissues ; exposition of different methods.
8. Staining tissues, etc., in mass. Simple and compound stainings.
9. Staining sections. Simple and compound stainings.
10. Section cutting—soft tissues. Use of various microtomes.
11. Section cutting—hard substances. Methods of cutting and grinding.
12. Section cutting. Serial sections.
13. Use of the Dissecting Microscope. Methods and apparatus.
14. Practical demonstration of the relation of aperture to power in microscope objectives.

15. Methods of manipulation, decantation, desiccation, isolation, etc.

16. Methods of measuring aperture, power, focal length, etc.

17. Methods of illumination for special purposes, special objects, etc.

18. Uses of the Mechanical Finger. Application to research, etc.

19. Electrical and thermal applications in research. Hot Stages, etc.

20. Uses of Live-Boxes, Growing-Cells, Compressoriums, Troughs, and special apparatus for investigations of special objects, etc.

21. Special methods of treatment or examination of special subjects of investigation, such as blood, pus, urine, etc.

22. Staining and mounting bacteria, micrococci, etc., for examination.

23. Special methods of cell-making, cementing, cover-cutting, etc.

24. Special methods of mounting, labelling, finishing, packing, storing, or registering slides. Finder Records, etc., etc.

It is expected that one or more workers will illustrate each of the above subjects. Many of the most efficient members of the Society have already promised their co-operation. Suggestions relating to the work in any respect are invited, and all who are willing to aid in illustrating any of the above, or other subjects not enumerated, are cordially requested to inform me as soon as possible what part of the work they will undertake, and communicate such information as may be needed in preparing for the suitable presentation of their exhibits.

164 Lake Street, C. M. VORCE.
Cleveland, Ohio.

CORRIGENDUM.—For the words, "A New Microscope Stand, furnished by Mr. Green, successor to Mr. Tolles," in the January Number of the JOURNAL, page 26, substitute the words, A New Microscope Stand, made by Mr. Dalton, of Boston.

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THE PROPER CARE AND USE OF MICROSCOPE LENSES.

BY WILLIAM WALES.

(*Given April 3d*, 1885.)

However good the lenses of an instrument may be, they will not do their best work except when properly cared for and properly used. Yet I have met with reputable microscopists who do not in practice appreciate this obvious truth.

Let me show you how a lens is cleaned. My implements are four,—an old, soft, silk handkerchief, a small stick of soft wood, a phial of alcohol, and a watch-maker's glass of two powers.

I have here an eye-piece. I will first examine it with the magnifying glass, by reflected light, to learn its condition. If it be found to need cleaning, alcohol is to be applied with the handkerchief. This liquid must not be allowed to touch the lacquer ; but the cell which holds the lens will not be harmed by it, since that has been burned black with acid. If, after the cleaning, fibres from the cloth be found adhering to the lens, they may be blown off by a quick breath.

I have brought an objective which was sent to me to be cleaned. I will attach it to an instrument, and will place under it a slide of familiar diatoms. Now view the object through the lens. It looks so obscure that you will all exclaim, "Well, this is a very poor objective ;" whereas, it is of excellent quality, as you shall presently see. In it are eight pieces of glass. The back combination is composed of two crowns and the flint ; the middle, of a double-concave flint and a double-convex crown; the front, of two crowns, with a flint between them. It has, probably, not been cleaned for twenty years. Suppose your watch to have been thus neglected ! I will now clean this objective. I begin the work by unscrewing the cells. I then moisten a part of the handkerchief with alcohol, and, with the help, if needed, of the stick of wood in searching the corners, carefully clean each combination, and I then screw each cell back accurately to its place.—The work is now finished, and I will attach the objective again to the microscope, and will again ask you to view the slide of diatoms through it.—The dimness is now, you perceive, all gone. Indeed, you can hardly believe it the same objective; and you have ocular proof that cleanliness is essential to the best performance of a lens, and are witnessing an instance of the dependence of important results on attention to little things.

Several years ago, while I was getting ready to visit England, the owner of a Powell and Lealand objective wished me to take the lens to its makers for correction or exchange. "It is a poor lens," he said. I could not credit his statement, for I knew the work of the Messrs. Powell and Lealand to be faultless. I called on those gentlemen. We examined the objective together, and discovered on one of the combinations a film of some substance which could not be removed except with alcohol. In five minutes the lens was clean and in perfect order; and to this day the owner refuses to believe that the lens which I brought back to him is the same with that which I took abroad.

Never trust the cleaning of your objectives to the brass-worker, or to any person who does not know how carefully a lens ought to be handled. The brass-worker will polish the outside of the objective, but will get the lenses out of centre. To my great disgust, I once found a brass-worker subjecting one of my $\frac{4}{10}$ths-inch lenses to that treatment. I asked, "What are you doing with that objective?" "Putting it in order, at the request of its owner," he said: "he wants to sell it." Taking the lens, I cleaned it for him without charge.

A camel's-hair brush can neither completely nor safely remove the film of dust with which the exposed surface of the back combination of an objective is sometimes found to be coated. It will make a series of rings on the surface of the lens, and it may, if grit be present, scratch the glass. Nor should the handkerchief, either wet or dry, be introduced into the tube of any but a low-power objective. The cells must first be unscrewed from their mountings, and then the cleaning can be done properly. But, let me add,—

An objective ought never to be taken apart by any one but its maker. He has the lathe upon which it was made; and he alone, when the parts have been separated, can replace them in their original adjustment to the optical centre. Any other person will be likely to screw in the cells either too tightly or not tightly enough, and will thus throw the combinations out of their necessary delicate relation to one another. Besides, unless skill and care be exercised in screwing the parts together, the front and the middle combinations will sometimes be brought in contact, and the flint glass, which is very thin at the centre, will be broken. The screw-thread of the cells is very delicate. Yet some persons, after failing to catch it, apply force enough to break it. Such carelessness passes comprehension.

A large-angle oil-immersion lens gets out of order easily. If you find the definition of such objective to have lost its sharpness, you may know that the front lens is out of centre. It has come in contact with the slide. A very slight pressure is sufficient to work the mischief. This susceptibility to injury is unavoidable, as every optician will tell you. It is incident to the requirements of high-angle construction.

A few days ago an objective was sent to me with the request that the front lens should be reset. It had in some way been forced out of its place. I reset it as well as I could. But that objective, even if it had been repaired by its makers, the Messrs. Powell and Lealand, can never be what it was before the injury. The only way of repairing it was by inserting a ring of cement which, projecting slightly through the shoulder, necessarily cut down the angle. A heavy shoulder means, of course, a low angular aperture.

A novel method of using an immersion lens came under my notice recently. A water-immersion objective had been ordered. It was made and sent, but it did not give satisfaction. I inquired by letter, "In what way do you proceed to work with it?" "I fill it with distilled water, and then screw it to the instrument," was the reply.

An objective is sometimes almost ruined through sheer carelessness. I made a costly lens for a New-York optician. He tossed it several times in his hand, and finally dropped it upon the floor. "Oh," he said, "that will not harm it!" I looked at it, and found the front combination tilted at an angle of about forty-five degrees. This act of carlessness cost that optician twenty-five dollars.

I have here the back setting of a 1½-inch lens which was made by me several years ago. The purchaser of the lens had screwed it so tightly to his microscope that he could not, with his hand, unscrew it. So he used a pair of heavy gas-fitter's pliers, and succeeded in pulling the tube of the fine adjustment out of the body of the instrument. This rude handling damaged the microscope to the amount of forty-five dollars.

Quite recently the owner of an instrument which cost three hundred and fifty dollars told me that he had a wonderfully clever son. "Why," he exclaimed, "he has, with a screw-driver, taken the microscope all apart! He is unable, however, to put it together again." This outrage illustrates the incapacity of some people, old, as well as young, to appreciate the products of fine workmanship.

I do not favor the nose-piece. If you must have one, choose one that is of good design and thoroughly well made. Lenses, especially those of high power, ought not to be tested with the use of this accessory.

A superior lens, worked by an illustrious microscopist, becomes its maker's best advertisement. But when it falls into the hands of a careless or incompetent person, and is not carefully used or regularly and properly cleaned, to hold the maker responsible for its consequent unsatisfactory performance is to do him great wrong.

SPONGES.

BY PROF. HENRY J. RICE, SC. D.

(*Given April 17th*, 1885.)

To the morphologist few forms of life present more interesting objects of study than do the various members of the family of sponges, since in their life-history are found typified certain changes or conditions through which, modified to a greater or less extent, almost all other animals have to pass in attaining maturity.

The general aspect of the sponge, and its habit of attachment to some support, caused it for a long time to be considered a vegetable. But when the distinction between animal and vegetable life had become better understood, and the sponge itself had been carefully studied, both as to its manner of growth and its structure, it became evident that this organism belongs to the animal kingdom. Its exact position in that kingdom has not been fully determined ; but, without stopping at present to consider its Protozoan or Metazoan relationships, we may describe it as we know it,—either as a community of animals, or as a communal animal—one from many, or many from one.

Sponges are found mostly in tropical or warm seas where the water is moderately shallow, although certain forms occur in fresh water in temperate regions. They vary exceedingly in color, shape, and size, yet they can be placed for the most part in a few subdivisions. The classification is not, however, either fixed or entirely satisfactory as it now exists ; still, for all present purposes, a division may be made into the groups, or families, of the Myxospongiæ, Calcispongiæ, Fibrospongiæ, and Clionidæ. This classification is based on the absence or presence of spicules in the body-walls of the sponge, and on the composition of these spicules. In the Myxospongiæ the walls consist of sarcode, or protoplasm, alone. In the Calcispongiæ the tissue is strengthened by calcareous spicules, and in the Clionidæ the spicules are siliceous. In the Fibrospongiæ the framework of the body is of a fibrous nature, being made up of a substance called keratose. To this group are assigned the beautiful and delicate glass-sponges, although their framework is of silex.

How do sponges grow ? and what is the first stage of their life-history? The marine sponges begin life either from the egg or by budding. The fresh-water sponge, besides the development from the egg, may start from a minute seed-like body, or statosphere, which is formed in autumn in the walls of the sponge, and from which a germ, the true statoblast, emerges in spring to develop into the adult form. Owing to the spicules with which they are adorned, some of the statospheres are very beautiful. The classification of this family is largely based on the shape of these spicules.

The sponge of commerce is the keratose skeleton of certain members of the group Fibrospongiæ, all the living substance having been eliminated. We shall better see the difference between the sponge in this condition and the sponge in its natural state, if we first learn how the animal lives. In gazing down into the water in regions where sponges abound, the observer will descry, fastened to rocks and other supports, certain velvety plant-like objects which resemble bunches of compact sea-weed more than anything else. It would be difficult for the uninstructed to recognize them as sponges: yet such they are. If we take one of the simplest of these, we find that it is shaped somewhat like a vase. By its base it was attached to its anchorage. At the upper end is an opening, the osculum, leading into a central cavity, the ventriculus. The wall is (usually) of two layers. The inner consists of cells provided with long cilia, the outer with cells furnished with spicules The wall may be continuous, or it may be perforated with one or more pores through which water passes from without into the ventriculus. If the wall be thick, the pores will be many, and will represent as many canals leading to the central cavity. When these pores are so numerous as to lie close together, the ciliated cells are no longer observed on the wall of the main cavity, but will be found lining the canals. These cells, when sufficiently magnified, are seen to have a body-portion to which is attached the cilium, while around the base of the cilium and extending out from the body of the cell is a hyaline collar which gives to the whole a bottle-shaped appearance. The cell-body usually contains a nucleus, a nucleolus, and a contractile vacuole. These cells are the feeding organs of the sponge; and the cilia, by their motion, cause currents in the water and thus procure for the cells their food. Such food-particles as cannot be absorbed and appropriated are sent on with the general current into the ventriculus, from which they are expelled at the osculum.

The resemblance of these flagellate collared cells to monads, combined with the supposition that the sponge consists exclusively of communities of such cells, has caused this animal to be ranked as a Protozoön. But the study of the egg and its development leads me to a different view. The investigator will notice in the wall of the sponge, not only flagellate collar-bearing cells, such as have been described, but also, behind these, other cells of various kinds which are unciliated, and are sometimes seen grouped in small clusters. Some of these inter-tissue cells, situated just beneath the lining of a canal-wall, assume special functions; and by self-division each original cell becomes transformed into a little group of cells, some of which are large and some small. The smaller are ciliated and the larger not. The segmentation continues until an embryo is formed in which the large cells are upon one side, or the basal half, and the small cells occupy the other portion. The cell thus transformed is then passed out of the body-wall of the sponge into the canal, and is carried by the current of water which it there encounters, into the central cavity of the sponge, and thence through the osculum into the waters without. It is there moved about by its cilia and by the sea-currents until, striking some hard object, it anchors itself by its basal extremity. But, meanwhile, changes have been going on within the egg itself. The two kinds of cells have separated so as to produce a central or segmentation cavity, with the cells arranged as a shell or coating around the cavity—and the little animal forms what is known as a morula. A collarette of cells is then formed around the centre of the embryo, and by the multiplication of these and the other cells the segmentation cavity becomes nearly or quite obliterated. At the same time the ciliated cells of the outside of the embryo grow upward all around it, and soon a gastrula is the result—or a bottle-shaped animal with a central cavity which is lined with ciliated cells and is in communication, by many pores, with the waters without ; that is, we have a newly-formed sponge.

The flagellate cells with which we observe the interior of our newly-formed sponge to be lined—whence come they ? They are simply the exoderm cells of the original egg transformed into monads. Now, a monad is a Protozoön, since its growth does not involve change in cell-structure. But the development of the sponge does involve a process of differentation, and hence this animal ought, I think, to be ranked as a Metazoön.

I have spoken of the sponge as a community of animals. How is that community formed ? Returning to our sponge, and watching it carefully, as before, we find one or more buds forming on the outside. These do not begin as growths upon the exterior, but as eversions of the wall itself, which appear, at first, as indentations in the inner surface. Presently an opening is formed at the apex of the bud. This becomes an osculum, resembling that of the parent and performing the same function. These buds start early, and grow with the growth of the parent, and each bud becomes a centre from which other buds shall spring, from each of which proceed yet other ramifications. Since the original parent form, with the oldest buds or branches, grows a little higher than the others, we shall have, as the result of the successive buddings, a colony of a shape more or less globular. In other words, the sponge takes on the figure with which we are familiar, with pores throughout the mass, and exhibiting at or near the centre the osculum of the original sponge. Sometimes two large oscula are seen, corresponding to two growths, one of which branched off early from its companion. The ventriculi, old and young, of the entire colony, are in free communication with one another. In general it may be said that the water goes in on all sides and goes out on all sides, but tends to pass out by different openings from those by which it came in.

The foregoing description presents the sponge simply as a porous mass of sarcode cells. In other examples spicules are found attached to the outside wall in numbers so great as to invest it completely. These may assume every variety of shape and size, and are often of great beauty. Some are needle-like; others have the form of a three-pointed star; still others are crescent-shaped, with a long spur projecting from the middle of the convex side. These all interlock in such manner as to form a strong and complete net-work in the outer tissue of the sponge. Only occasionally do they extend through all the tissues.

But in this form the sponge is of no practical service. To be useful, it must be free from spicules and must have a framework of keratose. Where, then, and how is the keratose deposited? Some sponges have a layer of cells between the inner and the outer layers; in other words, mesoderm, as well as endoderm and exoderm cells. The keratose is generally formed as a mass of fibres interlacing in all directions through the mesoderm layer, and sometimes also embracing and thus firmly uniting the inner and the outer layers. The result of this growth in a sponge of this kind is that every canal in the whole sponge becomes inclosed in a tube of keratose, so that the keratose of the entire communal animal constitutes a framework of the same general form with the animal itself. Now, should you pluck a living sponge, of this variety, from its anchorage, you would find it feeling soft and slimy in your hand. The slimy substance is simply the sarcode of the exoderm cells, which envelops the whole sponge. The inner walls have also their layer of living cells. But the dealer in sponges wishes them rid of their sarcode. Accordingly, when the sponges are gathered from the sea-bottom they are taken to the shore and placed where the water can get access to them and wash away the protoplasmic matter. They are still further cleansed by the use of chloride of lime, by exposure to the sun, and by washing in water, until nothing but the keratose is left. They are then dried and packed and sent to the market. The closeness of the packing greatly changes their appearance; but, when freed from compression and soaked in water, they regain nearly their original size and shape. It is to the ease with which it absorbs and, under pressure, gives up, water, that the fibrous sponge owes its usefulness; and this property depends on the flexibleness and elasticity of the keratose fibres, as well as on the abundance of the canals which ramify among them.

In the quality of the keratose, sponges differ according to their habitat. Those occurring in United States waters are coarse. The finest grow along the coasts of Syria and Greece. These are detached from their beds with great care by the hands of divers who go down from vessels specially designed for this work. Among them is the famous Turkish cup-sponge, which is highly valued on account of the silk-like fineness and softness of its fibres. Its form gives it its name. A large specimen is costly. Indeed, in former times it brought almost its weight in gold. Sponges with coarse keratose fibre are less expensive, and are collected with less care. Of medium quality and cost is the "woolly sponge," so called from its resemblance to sheep's wool. It is soft, tough, and, for ordinary uses, good.

The ordinary keratose sponges are not beautiful; they are simply useful. The converse is true of the form called the glass-sponge. This occurs sometimes in very deep waters. In most cases its framework consists entirely of long and delicate glass-like spicules. One species, called Venus's Flower-basket, is shaped like a cornucopia, and grows sometimes to a length of twelve or more inches. Its fibres are so interlaced with one another as to form octagonal openings and present a sieve-like aspect. Of other forms of glass-sponge, some are globular, some oval. An abundance of fine intersecting fibres gives to these also a beautiful lace-like appearance. From the base proceeds a bundle of long glass-like threads by which the sponge is anchored to the sea-bottom.

The so-called boring-sponge, the enemy of the oyster, belongs to the group Clionidæ. Fastening itself to the shell of the oyster, this sponge eats into it, tunnels it, and sometimes pierces even the inner nacreous layer. The peculiar construction of the shell facilitates this work. The shell is made up of a succession of calcareous plates, which are more or less discontinuous, and are of increasing size as they recede from the umbo. These layers are hard, and strongly resist the saw. Between them is a soft packing, consisting of prismatic calcareous material, which cuts as easily as cheese. When, therefore, the sponge has bored through a hard plate of the shell, it spreads its branches readily through the soft material beneath. It is obvious that, especially where the packing between the hard layers has been rendered continuous because of a want of continuity in those layers, the work of destruction must be rapid, and that the shell will soon become disintegrated. I have seen oyster-shells which had become so thoroughly perforated by the boring-sponge that the two valves, when pried open by the knife, fell in pieces, leaving only two small plates where the adductor muscle was attached.

PROCEEDINGS.

Meeting of April 3d, 1885.

The President, Mr. C. Van Brunt, in the chair.

Thirty-three persons present.

OBJECTS EXHIBITED.

1. Fourteen Photographs of Diatoms; taken in 1876, by J. J. Woodward, Asst. Surg., U. S. A.: by A. Woodward.
2. Eighty-eight Diatoms, arranged in three rows; mounted by Mr. Peticolas: by C. S. Shultz.
3. Fifteen Diatoms, arranged in a star-shaped group: by C. S. Shultz.
4. Diatoms from Puget Sound: by C. S. Shultz.
5. Diatoms from Ajaccio, Corsica: by C. S. Shultz.
6. Five Slides of miscellaneous Diatoms: by C. S. Shultz.
7. *Conochilus volvox*, and *Volvox globator*: by A. D. Balen.
8. Iridescent shell of Baculite; from Dakota: by G. F. Kunz.
9. Ruby Copper, from Cornwall, England: by G. F. Kunz.

DR. WOODWARD'S PHOTOGRAPHS OF DIATOMS.

President Van Brunt attributed the excellence of Dr. Woodward's photomicrographs to the use of the wet-plate process and of sunlight.

Mr. Dudley said that the dry-plate process, although it has been greatly improved since its introduction, and is destined to further improvement, will probably never render the fine lines of diatoms with the precision of the wet-plate process.

DIATOMS FASTENED BY HEAT.

President Van Brunt: "Prof. Hamilton Smith has recently sent me an excellent slide of diatoms mounted in his newest medium and exempt from the mobility which drew forth criticism at the meeting of March 20th. The diatoms were fixed to the cover-glass by means of heat. When diatoms are fastened by this method, only so much heat should be applied as is found to be really necessary. Least heat is required when the diatoms are taken from a solution of alkali."

THE PROPER CARE AND USE OF MICROSCOPE LENSES.

Mr. Balen: "For cleaning the lenses of my microscope, I use an old silk handkerchief which has been cleansed from grease and from soap, and has been made soft, after drying, by being rubbed inside another handkerchief. The upper lens of the eye-piece I protect from dust by keeping over it a small circular piece of blue glass. It hence needs not that frequent cleaning which, if care be not used, endangers polish."

Mr. Wales, after expressing approval of Mr. Balen's method of cleaning lenses, described and illustrated his own. He gave also hints and cautions on the proper care and use of lenses, and sketched some curious instances of their maltreatment. His observations constitute the opening article in this Number of the JOURNAL.

MEETING OF APRIL 17TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Fifty-six persons present.

OBSERVATIONS ON SPONGES.

H. J. Rice, Sc. D., who was present as a guest, gave an Address, by invitation, on the subject of sponges. He treated mainly the life-history of the sponge of commerce, describing its development both from the egg and from the bud. He concluded his Address with a notice of *Cliona*, or the boring-sponge, and of the harm done by it to the oyster. He gave it as his opinion that the embryology of sponges ranks them with the Metazoa. His observations form the second article in this Number of the JOURNAL.

Discussion elicited the following matter :—

Mr. J. D. Hyatt : "The boring-sponge attacks shells and limestones. It sends out into them roots, or arms, which, through ramification, become smaller and smaller, like the mycelium of a fungus. The borings in even very hard marble reach sometimes a depth of more than two inches, and at their extremities they are microscopic.

"I have discovered no evidence that the health of the oyster is impaired by the boring of the sponge. The sponge does not feed upon the oyster. It has been observed in aquaria to attach itself quite as readily to a vacant as to an occupied shell. When its arms have penetrated to the inner surface of the shell of a living oyster, the mantle of the mollusk, becoming irritated by their presence, checks and, I think, stops the intruders by depositing at once an extraordinary quantity of nacre at the points of intrusion. You see as a result small elevations at those points. The shell may, at the same time, have become so far honeycombed in other directions that it can be easily crushed by the hand."

Prof. Rice : "The sponge does not, it is true, seek the oyster; yet the oyster is liable to perish in consequence of the disintegration of its shell by the borings of the sponge. This liability occurs in those cases in which the borings have weakened the innermost plate to such a degree that the part to which the adductor muscle is attached gives way under the traction of the muscle. The valves are then forced open by the tension of the ligament, and the oyster is left defenceless against its enemies.

"I have seen shells in which the borings seemed to penetrate, not only the nacreous lining proper, but also layer after layer of material which the oyster had deposited for the obvious purpose of protecting itself against the encroachments of the sponge."

A FILTER WASH-BOTTLE.

Mr. C. E. Hanaman, of Troy, presented to the Society a filter wash-bottle of his own invention and of easy construction. "It is especially adapted," said the donor, "for the use of histologists. The bottle is of the common kind, with a mouth an inch or more in diameter The cork is fitted with the tube of a thistle-top funnel, besides the usual delivery and air-supply tubes. The mouth of the funnel is furnished with a cork. To the end of the delivery tube is attached by an air-tight joint a short piece of larger tubing filled with filter-cotton. This is corked at its lower end, and into the cork passes a small tube terminating in a jet. Over this jet, when the apparatus is not in use, may be placed a small phial. This wash-bottle protects alcoholic solutions of staining agents from evaporation."

THE AMERICAN SOCIETY OF MICROSCOPISTS.

Mr. Hyatt: "I hope that as many members as possible of our Society will make an effort to attend the Annual Meeting of the American Society of Microscopists which is to be held this summer at Cleveland. Among the members of that Society are many of the most distinguished microscopists in the United States. The meetings are always valuable scientifically and pleasant socially."

PUBLICATIONS RECEIVED.

Brooklyn Entomological Society. Entomologica Americana: Vol. I., No. 1 (April, 1885); pp. 20.

The Electrician and Electrical Engineer: Vol. IV., No. 40 (April, 1885); pp. 40.

Journal of the Cincinnati Society of Natural History: Vol. VIII., No. 1 (April, 1885); pp. 72.

First Annual Report on the Injurious and Other Insects of the State of New York; pp 344. By J. A. Lintner, State Entomologist; Albany, 1882.

Proceedings of the American Academy of Arts and Sciences: New Ser., Vol. XI., Whole Ser., Vol. XIX., Pt. I. (May, 1883, to December, 1883); pp. 230. Pt. II. (May, 1883, to May, 1884); pp. 358.

Bulletin de la Société Royale de Botanique de Belgique: Tome Vingt-Troisième (1884); pp. 568.

Anthony's Photographic Bulletin: Vol. XVI., No. 7 (April 11th, 1885); pp. 32. No. 8 (April 25th, 1885); pp. 32.

The American Monthly Microscopical Journal: Vol. VI., No. 4 (April, 1885); pp. 20.

Elephant Pipes in the Museum of the Academy of Natural Sciences, Davenport, Iowa; pp. 38. By Charles E. Putnam.

The Midland Naturalist: Vol. VIII., No. 88 (April, 1885); pp 28.

Proceedings of the Natural Science Association of Staten Island: October, 1884, to April 11th, 1885; pp. 6.

The West-American Scientist: Vol. I., No. 5 (April, 1885); pp. 7.

The Journal of Microscopy and Natural Science: Vol. IV., Pt. 13 (January, 1885); pp. 64. Part 14 (April, 1885); pp. 70.

Proceedings of the Colorado Scientific Society: Vol. I., 1883 and 1884; pp. 28+144.

Die Natur, Halle, Prussia: New Series, Vol. I., No. 14 (April 4th, 1885); pp. 8.

The Microscope: Vol. V., No. 4 (April, 1885); pp. 24.

Nuovo Giornale Botanico Italiano: Vol. XVII., No. 1 (January 22d, 1885); pp. 48.

The Botanical Gazette: Vol. X., No. 4 (April, 1885); pp. 18.

The School of Mines Quarterly: Vol. VI., No. 3 (March, 1885); pp. 96.

Journal of the Royal Microscopical Society: Ser. II., Vol. V., Pt. 2 (April, 1885); pp. 208.

Bulletin of the Natural History Society of New Brunswick, Canada: No. 4 (1885); pp. 116.

The Microscopical Bulletin and Optician's Circular: Vol. II., No. 2 (April, 1885); pp 8.

INDEX TO ARTICLES OF INTEREST TO MICROSCOPISTS WHICH HAVE RECENTLY APPEARED IN OTHER JOURNALS.

Alga (*Œdogonium crassiusculum*), Filiform, Life-History of a (To be continued): M. C. Cooke.
Mid. Nat., VIII. (1885). pp. 74–6, and 89–94 (4 figs.).

Algæ of Fresh Water, Provisional Key to Classification of (To be continued): R. Hitchcock.
Am. Mon. Mic. Jour., VI. (1885), pp. 68–74.

Anatomical and Histological Methods, Some: O. P. Hay.
Am. Nat., XIX. (1885), pp. 526–9 (1 fig.).

Animal Metamorphosis (Pt. I.): J. B. Jeaffreson.
Jour. of Mic., IV. (1885), pp. 84–96 (13 figs.).

Bacilles courbes ou bacilles-virgules (*Komma-bacillus*), Sur la nature indifférente des, et sur la présence de leurs germes dans l'atmosphère: J. Hericourt.
Comptes Rendus, C. (1885), pp. 1027–9.

Bacterium lactis. See Lactic Ferment.

Batrachospermum moniliforme. See Cystocarps.

Chironomus prasinus (Pt. I.): A. Hammond.
Jour. of Mic., IV. (1885), pp. 65–74 (30 figs.).

Cystocarps, Formation of, in *Batrachospermum.*
Cole's Studies in Mic. Sci., April, 1885, pp. 9–12 (colored plate).

Dianella cærulea. See Petalody of the Ovules.

Dioön edule, Lindl., Descrizione Anatomica dell' Infiorescenza e del Fiore Femmineo del: G. Cugini.
Nuov. Giorn. Bot. Ital., XVI. (1885), pp. 29–43 (28 figs.).

Eggs of Vapourer Moth (*Orgyia antiqua*); under heading Graphic Microscopy: E. T. D.
Sci.-Gossip, 1885, pp. 73–4 (colored plate).

Embryology, Outlines of (Third paper).
The Microscope, V. (1885), pp. 81–5 (8 figs.).

Histological and Anatomical Methods. See Anatomical and Histological Methods.

Homogeneous-Immersion Objectives: A. Y. Moore.
The Microscope, V. (1885), pp. 73–5.

Immersion Illuminator, On a Cata-dioptric: J. Ware Stephenson.
Jour. Roy. Mic. Soc., V. (1885), pp. 207–11 (1 fig.).

Infusoria, Some New: Alfred C. Stokes.
Am. Nat., XIX. (1885), pp. 433–43 (10 figs.).

Intracellular Digestion, Abstract from an Article on, by Dr Elias Metschnikoff: H. G. Beyer.
Am. Mon. Mic. Jour., VI. (1885), pp. 61–5.

Lactic Ferment (*Bacterium lactis*), On Some unusual Forms of: R. L. Maddox.
Jour. Roy. Mic. Soc., V. (1885), pp. 205–6 (1 fig.).

Lantern Microscope, The. See Microscope.

Leech, Medicinal, The Physiology of the : JOHN B. HAYCRAFT.
Mid. Nat., VIII. (1885), pp. 98–100.

Microscope, The, and How to Use it (Pt. II.—On Mounting Microscopic Objects) : V. A. LATHAM.
Jour. of Mic., IV. (1885), pp. 96–104 (1 fig.).

Microscope, The Lantern : LEWIS WRIGHT.
Jour. Roy. Mic. Soc., V. (1885), pp. 196–204 (3 figs.).

Microbes, La Culture des, et l'Analyse biologique de l' Air et de l' Eau par les procédés les plus pratiques : HERMANN FOL.
La Nature, XIII. (1885), pp. 227–30, and 298–302 (10 figs.).

Molecular Motion ; under heading Pleasant Hours with the Microscope : HENRY J. SLACK.
Knowledge, VII. (1885), 318–9.

Mounting Microscopic Objects. See Microscope, The, and How to Use it.

Noyau Cellulaire, Nouvelles Recherches sur le, et les Phénomènes de la Division communs aux Végétaux et aux Animaux : M. LÉON GUIGNARD.
Ann. des Sci. Nat., XX. (1885), pp. 310–72 (84 figs.).

Œdogonium crassiusculum. See Alga.

Orgyia antiqua. See Eggs of Vapourer Moth.

Petalody of the Ovules and other Changes in a Double-Flowered form of *Dianella cærulea*, On. MAXWELL T. MASTERS.
Nature, XXXI. (1885), pp. 487–8.

Phanèrogams, Recherches sur le Péricycle ou Couche Périphérique du Cylindre Central chez les : M. LOUIS MOROT.
Ann. des Sci. Nat., XX. (1885), pp. 217–309 (50 figs.).

Pond-Life : WILLIAM EVANS HOYLE.
Jour of Mic., IV. (1885), pp. 105–13 (26 figs.).

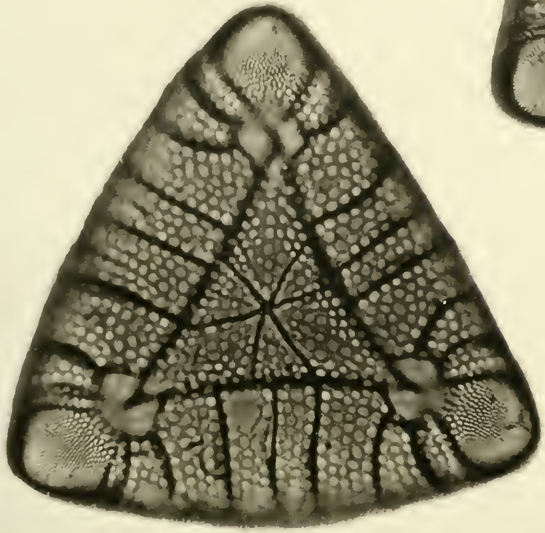
President's Address, The (Royal Microscopical Society) : W. H. DALLINGER.
Jour. Roy. Mic. Soc., V. (1885), pp. 177–195 (42 figs.).

Rocks, The Microscopical Study of : JOHN ERNEST ADY.
Ill. Sci. Mon., III. (1885), pp. 99–103. (4 figs.).

Staining Tissues in Microscopy (To be continued) (HANS GIERKE, *Zeitschr. für Wiss. Mic.*) : Translated by W. H. SEAMAN.
Am. Mon. Mic. Jour., VI. (1885), pp. 65–8.

Tradescantia Virginica, la Division des Noyaux dans le, Note sur : E. BERNIMOULIN.
Bul. Soc. Roy. Bot., Belg., XXIII. (1884), pp. 7–14 (17 figs.).

PLATE 1.



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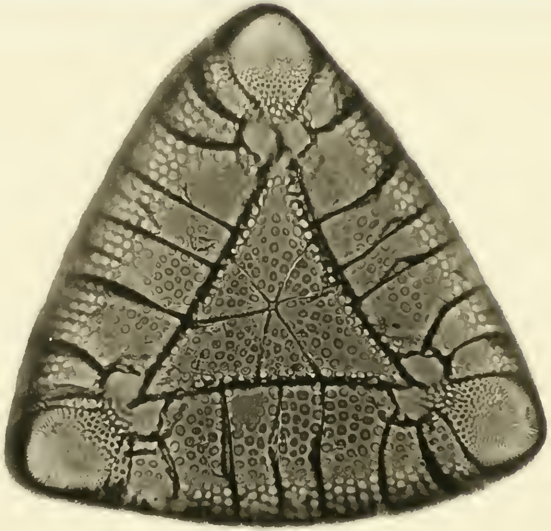

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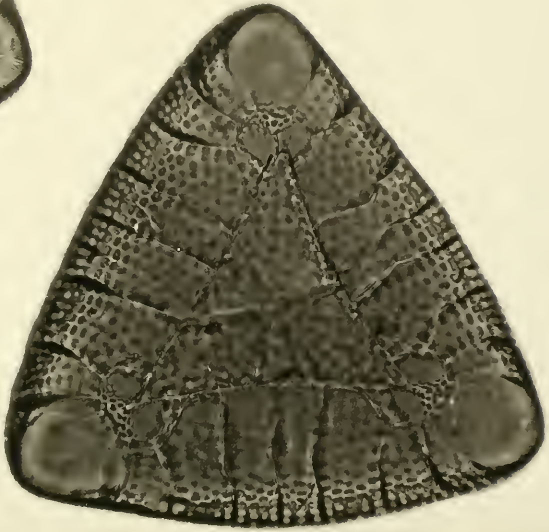

3.

TRICERATIUM DAVYANUM, Grev.

ARTOTYPE. E. BIERSTADT. N.Y.

JOURNAL
OF THE
NEW-YORK MICROSCOPICAL SOCIETY.

VOL. I. JUNE, 1885. No. 6.

THE SEALED FLASKS OF CRYSTAL.

BY ALEXIS A. JULIEN, PH. D.

(*Read May 15th*, 1885.)

To the loot of Pekin the art-lovers of the world owed their first thorough knowledge of the curious images, balls, vases and flasks carved, often grotesquely, in the very hardest materials—jade, agate, and rock-crystal—by the skilful artificers of China and Japan. Such an object owed its interest, not only to the beauty of its form, but also to the lustre, transparency and imperishability of its material, and, often, to its priceless value, as representing an entire lifetime of patient labor.

But Nature has gone even farther, having produced, in the so-called fluid-cavities of the harder minerals, flasks and vases still more minutely and deftly worked and of vastly greater antiquity, filled, besides, with strange liquids and gases, and then hermetically sealed forever with the very material of the flask itself. A kind of romantic and even artistic interest has been manifested by mineralogists and microscopists toward these delicate inclosures, and much careful study has been bestowed upon them. It is not the purpose of this paper, however, to review the literature of the subject, nor even to describe these fluid-cavities in detail, but simply to present such suggestions in regard to the collection and preparation of specimens, the choice of objectives and accessory apparatus, and the common method of examination, as may smooth the path for the study of these cavities by the general microscopist who may not have made microscopic lithology a specialty.

Contrary to the general belief, the material which contains these cavities is not rare. All the harder crystallized minerals have them, and the conditions for their easy examination are presented everywhere in our common gems,[1]—the diamond, ruby, sapphire, emerald, aquamarine, tourmaline, fluorite, chrysoberyl, and, above all, the topaz[2] and the amethyst. Many a microscopist is unaware of the beautiful inclosures which are to be found in the jewels in the possession of his own family, and which can generally be examined even without removing the gems from their setting, the jewels being merely held in the stage-forceps under a low-power objective. To prevent interference by reflection from the many facets, a temporary mount may be made by cementing to the gem a thin cover-glass with a drop of thickened but cold balsam. After examination, the balsam can be removed by immersion a short time in benzine or spirits of turpentine. Many lapidaries and dealers are aware that the flaws which occur in gems and greatly decrease their value consist largely of inclosures ;—sometimes minute inclosed crystals of other minerals ; sometimes cavities filled with some gas and beautifully faceted with the crystalline form belonging to the material of the gem ; sometimes cavities of a great variety of forms, filled partly or wholly with a liquid in which floats a bubble of gas, and having, perhaps, minute crystals of other gems or cubes of salt clinging to their walls. The day may soon come when, as a matter of scientific interest, those who possess a gem will pride themselves on the flaws which it contains rather than on their absence—at least, so far as the flaws represent either included crystals or fluid-cavities.

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[1] Isaac Lea: Proc. Acad. Nat. Sci. Phila., 1869, Feb. and May; and 1876, May.—H. C. Sorby and P. J. Butler: Proc. Roy. Soc., London, 1869, XVII., p. 291.

I shall invite your attention this evening to the subject of the fluid-cavities in quartz, or rock-crystal, putting aside altogether those contained in other minerals.

The first point claiming consideration is the selection and preparation of material. The material is plentiful in which these cavities occur in forms of great variety and with fluid contents of an exceedingly interesting character. The number of localities at which such specimens have been found has increased largely within the last few years, and it is probable that in a short time any investigator of this subject will know where to look for suitable material without leaving the place in which he resides. It can be procured in abundance on the island of New York from several sources ; viz., the quartz-grains in the common

[2] Sir David Brewster. See, for ref., J. D. Dana's "System of Mineralogy," articles Brewsterlinite and Cryptolinite ; also Phil. Mag., 1847, (3), XXXI., p. 497 ; 1853, (4), V., p. 235; etc.—R Th. Simmler : Pogg. Ann., 1858, CV., p. 460.—H. Vogelsang and H. Geissler : Pogg. Ann., 1869, CXXXVII., p. 56.—Alexis A. Julien : Jour. Am. Chem. Soc., III.

rocks of the island ; the fibrolitic gneiss[3] near High Bridge, and indeed all the other forms of gneiss, schists, and granyte ; the smoky quartz which occurs in the granyte veins ; the quartz-grains in many of the coarser granytes and sandstones which are imported into the city, in great variety, as building stones ; and even many of the quartz-grains in the sand of our seashore, as at Coney Island. The smoky form of quartz is almost always a vein quartz, of very common occurrence on our island, and familiarly known to all our collectors of local minerals. Especially on the west side of the city, all the way up from Sixtieth-street to the upper end of the island, very nearly, wherever excavations are going on for opening streets or for the foundations of buildings, the granyte-veins, carrying this form of quartz, are conspicuous.

The matrix of the quartz has been deposited by heated solutions in fissures of the gneiss, often producing an alteration of the gneiss in its neighborhood. One form of the deposit is the smoke-colored variety of quartz, which is filled with minute fluid-cavities. Its color is not necessarily due to the presence of cavities : it has been attributed to a bituminous substance disseminated through it. Dr. Lea, of Philadelphia, has stated[4] that the fluid-cavities "are in smoky quartz much rarer" than in transparent rock-crystal—evidently referring to the larger cavities visible to the eye. However, the minute cavities are invariably present in vast abundance through smoky quartz.

Interesting localities elsewhere, at which quartz of this variety, containing fluid-cavities of remarkably large size, is to be found, are Branchville, Conn.,[5] Chester, Penn., and White Plains, N. C. The Branchville material has been already very fully described. In the material from Chester—which was sent to me by Mr. T. D. Rand, of Philadelphia—the cavities are occupied by brine, holding cubes of salt and occasional hexagonal crystals of another mineral, and by liquid carbon dioxide and its gas. The quartz from White Plains—which locality has been described by Mr. W. E. Hidden[6]—has yielded the largest and most remarkable cavities, holding carbon dioxide, on record. Thin sections of the smoky quartz from all these localities are on exhibition here to-night.

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[3] A. A. Julien : "On the Fissure-Inclusions in the Fibrolitic Gneiss of New Rochelle, N. Y." Am. Quar. Mic. Jour., Jan., 1879, pp. 3-15.

[4] "Further Notes on 'Inclusions' in Gems, etc." Proc. Acad. Nat. Sci. Phila., 1876, p. 6.

[5] G. W. Hawes : Am. Jour. Sci., 1881, XXI., p. 203.—A. W. Wright : *Idem*, p. 209.

[6] Note on "Fluid-bearing Quatz Crystals." Am. Jour. Sci. and Arts, (3), 1883, XXV., p. 393.

But in addition to these natural sources of material, there are artificial substances, represented also by slides on exhibition, which may well illustrate many of the conditions that have affected the origin and development of fluid-cavities in natural crystals. Examples of these are exhibited in crystals of common salt, colored reddish or yellowish by potassium dichromate. The readiest mode of their preparation is the following.[7] A solution of potassium dichromate is taken, just strong enough to appear red to the eye. This is saturated with common salt in fine powder, and the mixture is freed from the excess of salt and from impurities by filtration. The solution is allowed to crystallize very slowly in a flask, loosely covered by paper, in a warm place. The hopper-shaped crystals of salt are not produced under these conditions on the surface, but little cubes are deposited over the bottom. These do not fall down in the ordinary transparent form of crystals of common salt, but are clouded, and colored yellowish to reddish. On examination of the slides under the microscope, it will be seen that the cause of the cloudiness is the saturation of each salt-crystal with thousands of fluid-cavities that are partly filled with liquid, partly with a gas, the liquid being a solution of potassium dichromate caught up during the crystallization of the salt, and being red or yellow according to its strength, and often containing still more minute crystals of the same red salt. These clouded crystals are not mounted in the original colored solution, but simply in a colorless saturated solution of common salt, or in castor oil, or in Canada balsam, inclosed in a wax cell. We have in the simultaneous formation of these artificial crystals, their cavities, and their inclusions, conditions and results closely corresponding in a general way to those which have occurred in nature in the formation of crystals with fluid-cavities.

In preparing for microscopical study the common material from this island, two easy methods may be employed. One is the grinding of thin sections. This method has been fully described, in the English language, in the well-known works of Rutley and Beale.[8] A single suggestion may be added to

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[7] H. C. Sorby: Quar. Jour. Geol. Soc., 1858, XIV., pp. 4–6.

[8] F. Rutley: "On the Study of Rocks," p. 59.—L. S. Beale: "How to Work with the Microscope," Fifth Edition, p. 212.

Sorby's description, given in the latter work, in which he calls special attention to the necessity of avoiding the use of polishing powder. For grinding a thin section of a compact mineral, polishing powder is appropriate, because there are no cavities which will absorb it. It is not necessary, therefore, to use a cover-glass upon a thin section of smoky quartz : it is preferable to polish the upper surface. In the preparation of thin sections of a granular mineral or of a true rock, however, polishing powder must not be used, since the scales of mica and the cleavage planes and other crevices, which occur in a rock section, would be likely to become filled with the powder, and the usefulnes of the section would thereby be destroyed. Nor should such thin section be of too great thinness, lest the larger cavities be emptied. For the proper examination of these, a thickness of one millimetre, or even much more, will not be too great, so long as the cavities of the size desired are preserved and their position is sufficiently near the upper surface to be within the focal distance of the objective employed.

Another and simpler method of preparation is applicable to many compact specimens of the mineral ; viz., chipping off thin flakes by a quick sharp blow of a small hammer, and mounting them in thickened balsam under a cover-glass, or in ordinary balsam or damar in a cell. Unfortunately, in many cases, especially where the liquid contents consist largely of liquid carbon dioxide, and a condition of extreme tension prevails, the material is apt to be so extremely brittle that the least jar causes it to crumble into angular fragments, unsuitable for mounting, and with the largest and most interesting cavities emptied. Such a material will also decrepitate when heated, sometimes with very great violence, flying into powder and projecting the particles out of the test-tube or vessel. Special precaution must be taken, in mounting either a flake or a thin section of so fragile a material, lest it be fractured by heat. The thin section may be cemented upon the slide by a film of balsam, previously thickened by heating ; and, immediately after pressing down the section, the manipulator may quickly cool the whole mount by blowing upon it, or by resting it upon a cold metal plate.

Thin sections which contain very minute cavities, and which may therefore need examination under high-power objectives, should, of course, be mounted under the thinnest covers. If an examination of the "critical point" of the contained liquid is to be made, by the method and with the immersion-apparatus to be described presently, it will be of advantage to mount them on slides of the thinnest material and shorter than those generally used by lithologists (45 mm. x 26 mm.), in order to diminish the diameter of the tank and the volume of the water employed in that apparatus. It will be well to mark such slides with a diamond point in place of using a paper label.

The selection of objectives for the study of these sections is not difficult. Although high powers are necessary to reveal some of the phenomena connected with the fluid-cavities, very low powers will answer for most purposes. Ordinarily, a power magnifying four hundred diameters is the most useful. Lenses ranging from a one-fifth to a one-eighth have been the most useful to me. Yet there are times when a power as low as that of a half-inch objective can be used, even for the study of the minute cavities in which there are moving bubbles. Of course, the very highest powers are often desirable in examining other cavities, with the limitation already expressed, that the cavity must be so near the surface as to be within the focal distance of the objective.

Transmitted light is, of course, requisite for the study of these cavities, but reflected light or that produced by dark ground illumination is sometimes the most ready means for their first discovery in running over a thin section of rock containing grains of quartz. Most cavities contain more or less gas, and this causes them to reflect the light like drops of molten silver and to catch the eye far more quickly, often, than if they had been first examined in the ordinary way.

The thorough examination of the more minute cavities will often require a command of all the resources to be found in the substage condenser, the use of the diaphragms, and the position of the mirror, for modifying the intensity and obliquity of transmitted light. The variety of forms and of refractive appearances presented in the fluid contents of the cavities, the effects of the irregular shapes and projections of the cavities and of the reflection of light from their walls, and the curious images produced by the irregular distribution and aggregation of other cavities in different focal planes, often cause perplexing phenomena, which are likely to mislead the judgment.

The chemical nature of the liquids and gases which occupy the cavities can be readily detected by chemical means. For example, the carbon dioxide, to the presence of which in the cavities of some specimens allusion has already been made, can be identified by simply crushing a fragment of the quartz in a mortar, under baryta-water, or by examining the gas with a spectroscope after expelling it by heat from a flask into a Geissler tube. A few simple microscopical accessories may be also employed for the same purpose The expansion of this gas by a slight increase of temperature above 20° C. is so great that advantage can be taken of its peculiar sensitiveness in this respect for its identification, on this minute scale, by very simple means. The simplest of all is a piece of rubber tubing, about one foot in length and one-eighth of an inch in bore. If the peculiar limpidness and delicate outline of the liquid in a fluid-cavity should lead the observer to suspect it to be liquid carbon dioxide, he has but to put this tube to his mouth and blow a gentle stream of warm air for a minute or two upon the slide, from either above or below the stage. The simple warmth of his breath (about 32° C.) will be sufficient to convert the liquid carbon dioxide into a gas and thus to render its identification at once complete ; for that temperature allows at least one degree to spare in reaching the point in the pure substance (31° C.) at which this change of state takes place. If there happens to be a gas-bubble of large size in relation to the layer of liquid in the cavity, the increase of temperature tends at the same time to expand the gas, and to cause the liquid to evaporate into the inner space. These two actions usually so counteract each other that hardly any change is visible. At other times an appearance of boiling is produced. But when the temperature of 29° to 31° C. is reached, in an instant the liquid layer disappears and nothing is visible within the cavity except the blurred outlines of its walls. The precise temperature at which liquid carbon dioxide thus passes entirely into the gaseous form within the cavity, is termed its "critical point." This is a condition affecting all liquids, that is, all condensed gases ;—at a certain fixed temperature—which varies with the gas—the liquid flies into the gaseous state when heated in an inclosed cavity the walls of which are strong enough to resist the enormous pressure so resulting. When the slide has cooled back to the critical point (about 31° C.), the inclusion suddenly resumes the visible form it possessed before, or sometimes assumes the form of two or three bubbles, or even occasionally of a cluster or of a shower of bubbles. If the original gas-bubble happens to be much smaller in volume than that of the inclosing liquid, and the slide is warmed gently in the same way, the bubble will be seen to dilate steadily, often rapidly, with a similar sudden disappearance of the liquid layer near the critical point. In all such experiments the observer must be on his guard as to the temperature of the atmosphere and of the mineral section at the beginning of the observation. In a warmly heated room, during the winter, and on a warm day, during the summer, the critical point may have been already passed and these transformations have become completed. In these circumstances no indications of the presence of carbon dioxide will be visible at the first observation unless care has been taken to keep the slide under examination cool, *i. e.*, below 30° C., which may be done by previously dipping it in cool water. The temperature of the air at midsummer in this city (30° to 33° C.) is often sufficient alone to bring the liquid up to its critical point, under the eye of the observer.

In most mineral sections the fluid contents of the cavities consist of water or some saline solution, which would usually remain but little affected in form or appearance during an experiment like that just described. Occasionally, however, the bubbles in a water-cavity are excited into lively motion and repelled into the farthest side of the cavity by the sudden application of heat. In place of a rubber tube, the application of a warm wire, glass rod, or of the burning end of a cigar, a little below the slide, may be substituted to produce the same effects—or even the direct application of the warm end of one's finger to the bottom of the slide for a few minutes.

It may be here remarked that the violent explosion of granyte when exposed to high temperature, as during the great fire in the business districts of Boston, may be attributed largely to the known abundance of liquid-cavities in the quartz-grains of that rock. This is represented by the slides, on exhibition, of thin sections of the coarse Quincy granyte, and of the similar hornblendic granyte from the Egyptian Obelisk now in our Central Park. In both these rocks, the quartz contains many large cavities holding water, and sometimes gaseous carbon dioxide, its liquid, or all three, in the same thin section.

For the exact determination of the temperature of expansion of the liquid in these cavities, many instruments have been devised, all belonging to the class called warming-stages. In these, recourse is had sometimes to the use of a current of heated air or of heated water, or to the conduction of heat by a metal plate. Most of these are extremely inaccurate, often complex, and untrustworthy, and it may be owing to this cause that Brewster obtained, for the critical temperature of the liquids in quartz, results of the very wide range between 20° and 51° C. As only the specialist in lithological investigation will ordinarily have recourse to such apparatus, it will be sufficient for the purpose of this paper to refer simply to a review of the subject, already published,[9] and to the description therein contained of a simple immersion-apparatus which I have devised. Brewster, Sorby, and Hartley had used the same principle, while they employed the method which is indicated in the following language: "To determine the critical point of the new fluid, immersing the slide in water of known temperature, removing, wiping it hastily, placing it on the microscope stage, and instantly examining it, seemed preferable to any other mode of operating."[10] I obtained, however, with greater convenience, far more accurate results by means of an apparatus permitting the slide to remain under observation, immersed in a layer of water on the stage of the microscope, and continuously warmed by a current of air from the breath of the observer, or, if necessary, by the conduction of heat to the bottom of the vessel from a small flame at the side of the stage. By this means an accurate determination of the actual temperature at which a fluid inclusion expands into a gaseous state may be obtained in a few minutes to the one-twentieth of a degree, centigrade.

The simplest form of this apparatus, which is inexpensive and can be fitted up by any microscopist, consists of three parts, as follows :—

1. A shallow glass tank, such as may be cut off the bottom of a chemical beaker, of sufficient diameter for the slide to lie within it, just immersed in a thin layer of water, but separated

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[9] Jour. Am. Chem. Soc., Vol. III.; Am. Mon. Mic. Jour., 1884, pp. 189–90; Proc. Am. Assoc. Adv. Sci., 1884.

[10] Hartley: Jour. Chem. Soc., London, 1876, p. 139.

from the bottom by two little blocks of rubber or glass. This tank is placed upon the stage of the microscope.

2. A chemical thermometer of sufficient delicacy, with a short bulb, or with a long bulb bent at a right angle. This is inserted in the tank, as nearly upright as possible, and the depth of the water is made just enough to cover the bulb. The length of the scale should be such as to bring the degrees between 27° and 32° near the level of the observer's eye when it is at the eyepiece, to facilitate immediate observation without the delay caused by moving the head.

3. A piece of small rubber tubing, tied to the body of the stand, with the upper end inserted in the observer's mouth, and with the lower end, which terminates in a short piece of glass tubing drawn to a fine aperture, lying in the water on the bottom of the tank.

An immersion objective may be employed, or, if the cavity be large, any objective of lower power may be used, with its front immersed in the water. After the cavity has been brought into sharp focus, a steady but gentle stream of air is blown through the tube, the immersion of the objective preventing interference from the waves on the surface of the agitated water. The cavity is continuously observed, as the bath and the immersed thin section are gradually warmed by the current of the observer's breath, and when the critical point is reached and the liquid contents of the cavity suddenly disappear, a quick observation of the thermometer is made.

Again, as the bath cools,—which process may, in hot weather, be hastened by adding carefully a few drops of cool water, with continual agitation by the air current,—the original bubble may be observed to leap back into view, and a second observation of the thermometer is taken as a check to the first.

If a higher temperature be required for other uses of this apparatus, an oil or other liquid may be substituted for the water in the bath, and it may be heated by conduction, from a taper or lamp burning by the side of the stage, through a stiff slip of copper introduced beneath the glass tank. A small hole, for observation, through this copper slip, should be placed immediately over the centre of the aperture of the stage. The apparatus may be further protected from radiation of heat, and more uniform results ensured, by inclosing the tank in a ring of pasteboard or sheet cork, and by inserting plates of cork between the copper plate and the stage.

The general size, form, and contents of the fluid-cavities have been very fully described by numerous observers, and, in the absence of illustrations, they need be only briefly referred to in this paper.

The size of the cavities varies greatly. Sometimes they are visible to the eye, rendering the sections of quartz cloudy. In others, when they are held up to the light, one can see the individual cavities. Other thin sections swarm with the most minute forms visible within the reach of our highest magnifying powers, and probably far beyond. In the quartz-grains of most quartzose rocks,—*e. g.*, granyte, gneiss, schists, and sandstones,—the smaller-sized cavities are very common, though invisible to the eye. Those which are large enough to be visible to the eye may be sought in some quartz crystals, in smoky quartz, and in Brazilian topaz ; but they are somewhat rare as yet, even in specimens of these minerals. About a quarter of a century ago all the mineralogical cabinets contained crystals of quartz from Little Falls, N. Y., in which were little cavities containing water and bitumen—the latter often floating on the surface within the bubble. Perhaps the largest liquid-cavity known is that inclosed in the famous specimen of calcite once in the collection of the late Prof. Chilton, a chemist, of this city. This cavity contains nearly two gills of liquid. The specimen is said to be now in the collection of Mr. C. Bement, of Philadelphia.

The shapes of the cavities are almost infinite in variety, generally rounded, often full of projections, and frequently displaying crystalline outlines. These have been called negative crystals, since they are simply cavities possessing planes, angles, and general crystalline forms, corresponding to those of the crystal in which they are included.

The numbers of these cavities in smoky quartz are beyond all statement, and often diminish its specific gravity by several hundredths. In a Cornish granyte the fluid-cavities of the quartz were found on an average not more than $\frac{1}{1,000}$th of an inch apart, equivalent to a proportion of a thousand millions in a cubic inch of quartz. As this mineral occurs in enormous quantity throughout our rocks, a vast amount of liquid gas must be thus locked up under our feet. In the smoky quartz of

Branchville, Mr. Wright found about seven-hundredths of one *per cent.* of liquid. In the quartz of the Cornish granytes the cavities sometimes make up at least five *per cent.* of its volume, and the water in them, on an average, about one *per cent.* of its volume, or four-tenths of one *per cent.* of its weight. As the quartz-grains in a granyte or in gneiss rarely amount to less than fifty *per cent.* of the whole rock, it is probable that the liquid contents of such a granyte commonly reach as much as one-fifth of one *per cent.; i. e.*, about four pounds of liquid to a ton of the rock.

The contents of these cavities are, in general, air or nitrogen or some other gas, such as carbon dioxide ; but nitrogen seems to predominate. In studying a section, one will often be surprised to observe the wide variation in the character of the different cavities in close approximation. Some are completely filled with liquid, some half filled, some empty,—that is, occupied merely by gas. The most common inclusion in the cavities consists of a liquid, usually transparent and colorless, which may be either water or brine. By brine I mean a solution more or less strong of some salt, often supersaturated. One or more crystals of the salt are often seen adhering to the walls. On gently heating a thin section containing an inclusion of this kind, the crystal sometimes disappears, and, on cooling, it reappears, occasionally in the form of several crystals. These crystals consist mostly of potassium chloride, sodium chloride, and calcium sulphate, or gypsum. They are generally attached firmly to the sides, or wedged in some narrow corner. Some have been found loose, so that, on revolving the section, the crystal was seen to tumble around the cavity ; but this occurrence is very rare. It is of interest to note, that in not a single case has the "Brownian Movement" been observed to affect the crystals or other solid particles occurring in a fluid-cavity.

The occurrence of carbon dioxide in these cavities has been already mentioned. Its liquid form has a specific gravity of only 0.6, water being taken as unity. This may be easily recognized,[11] when it nearly fills a cavity, by the peculiar limpidness of the liquid and its freedom from color, by the delicacy of the outlines of the gas-bubble floating within it, and by the phenomena of dilatation produced by a gentle heat. Other cavities contain two liquids,—the heavier saline solution next the wall and enveloping the salt-crystals, and the lighter carbon dioxide within. In this case three outlines are usually exhibited in each cavity,—that of the cavity itself on the outside, then the limiting line between the layers of saline solution and carbon dioxide, and, within, the circular outline of the gas-bubble. In some cavities the volume of the gas-bubble is very large in proportion to the amount of liquid carbon dioxide. On heating, there ensues, in this case, a rapid evaporation of the liquid into the inner space. Thilorier has stated, in the record of his laboratory experiments on tubes partly filled with this volatile liquid, that when half full, such a tube acted as a retrograde thermometer, the increase of temperature being marked by a diminution of the volume of the liquid on account of its vaporization ; but, when two-thirds full, it served as a normal thermometer of great sensitiveness, the volume of the liquid expanding with the rise of temperature. So, in these cavities with large bubbles, the amount of liquid carbon dioxide present is so small that, at the temperature then prevailing, it is reduced to so thin a layer as to be insufficient to wet any longer the inner surface of the saline layer. Then the saline solution lies as usual next the wall, with a huge gas-bubble immediately in contact ; but within the latter lies the limpid liquid carbon dioxide gathered into a ball, the liquid and gas having interchanged positions. All these varieties of condition may be distinguished after a little study, especially by noting the depth of the dark rim or shadow of the outline of the lighter liquid next the denser, or of the gas-bubble next either liquid—the depth of the shadow being in each case proportionate to the difference in density of the two fluids.

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[11] See the excellent papers by W. N. Hartley, Jour. Chem. Soc., London, 1876, pp. 137–43 ; and 1877, pp. 237–50.

In some cases the bubble adheres firmly to the wall or corner of a cavity and cannot be dislodged. Commonly it runs freely around the wall of the cavity, as the thin section is rotated upon the stage, always, of course, adhering to the uppermost side of the cavity as in a natural spirit-level. Thus it might be fancied that any sagacious gnome, having lost his way in the subterranean recesses, might determine his reckoning, as to up and down, by the position of the bubbles of the liquid-cavities in the rocky walls surrounding him.

An interesting feature of the smallest cavities, usually less than

$\frac{1}{1,000}$th of an inch, often $\frac{1}{50,000}$th of an inch in diameter, is the so-called spontaneous motion with which the inclosed bubbles are affected. Some may be seen under a high power (a $\frac{1}{8}$th-inch or $\frac{1}{10}$th-inch objective) vibrating gently, others rolling to and fro, and others dashing from side to side in restless motion. This motion may be very rarely seen even in cavities visible under a $\frac{2}{3}$ds-inch objective, or a magnifying power of about sixty-five diameters. Its cause has been connected pretty certainly with unequal thermal conditions on the sides of the cavities, producing alternations of evaporation and condensation within the space of the bubbles. Their motion thus serves as an index of the delicate balance which must prevail throughout the fluid, under pressure of its own vapor, within the cavity. Occasionally, bubbles in motion have been seen to stop, even permanently; others have begun their motion under the eyes of the observer, and continued it as long as they remained under examination. I am not aware that this spontaneous motion of the bubbles has yet been observed in the fluid-cavities of artificial crystals.

A curious phenomenon has been occasionally noticed by the experimenter while heating the fluids in a cavity of rock-crystal. At a certain temperature, in one case as high as 150° C., the gas-bubble becomes more dense than the liquid and sinks to the bottom of the cavity. "The cause of this motion appears to be that the bubbles consist of a gas so highly compressed that it is nearly of the same density as water at the ordinary temperature. On heating, the water expands, thus still further condensing the gas in the cavity, which then becomes heavier than the liquid, and consequently sinks in it."[12]

In closing, I may refer briefly to a few practical applications of the facts which have been discovered in reference to fluid-cavities. As in the sedimentary rocks fossils are necessarily relied upon for the determination of their life-history, so especially in the crystalline rocks have these fluid-cavities served a most useful purpose for determining the genetic history—the conditions which obtained during their formation or alteration. So exact is that statement that geologists have ascertained, within perhaps one thousand feet, the exact depth at which certain rocks were formed in England, and the exact pressure to which others in Scotland were subjected (represented in the

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[12] W. N. Hartley: Jour. Chem. Soc., London, 1877, pp. 237–50.

Scotch granytes imported into this city as building stones), during the folding up of the strata into mountains. The heat produced in the course of this tremendous compression of the rocks has left its record in the resulting crystalline condition of these rocks and in the fluid-cavities which they contain.

An investigation of great interest was prosecuted by Messrs. H. C. Sorby[13] and J. C. Ward,[14] of England, to ascertain the conditions of temperature and pressure which have prevailed during the formation of certain Scotch and Cornish rocks, especially granytes and elvans, in which such partly filled cavities occur. It was established by them that the bubble floating upon the liquid represented the vapor-filled vacuity left by the contraction, by cooling, of the liquid which must have originally filled the heated cavity. The determination of the temperature (89° –356° C.) at which the liquid could be artificially compelled to resume its original condition and volume at the time of the genesis of the crystalline rock, and of the relative change in its volume, gave a measure of the depth below the surface at which this temperature prevails, and of the superincumbent pressure necessary to produce the required tension in the cavities. By reasonings of this kind, it was estimated that the Scotch granytes were consolidated under pressures varying from sixty-nine thousand to seventy-eight thousand feet of rock at a temperature between 200° and 360° C. (a dull red). These cavities may be looked upon as offering a like record of past thermal experiences to that which we now obtain by means of maximum thermometers and pyrometers. For such investigations it was necessary to select peculiarly symmetrical long cavities of tubular or cylindrical form, the volume of which could be measured approximately, and that of the liquid they contained. Such tubular cavities are particularly common along certain planes in the white Brazilian topaz, and are often connected irregularly in pairs or even in groups of parallel tubes. In one case, a pair so connected, in a U-shaped figure, contained bubbles and portions of liquid (carbon dioxide) so delicately balanced in the opposite arms, that the whole arrangement could be made artificially to act very much like a differential thermometer.

We owe to Geo. W. Hawes the detection in one instance, in

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[13] Quar. Jour. Geol. Soc., 1858, XIV., pp. 453-500 ; and Min. Mag., 1877, I., p. 41.

[14] Quar. Jour. Geol. Soc., 1875, XXXI., p. 568 ; and 1876, XXXII., p. 1.

New Hampshire,[15] of the apparent conditions by which the carbon dioxide was actually formed in the cavities of the granyte at that locality, *i. e.*, by expulsion from a limestone in contact with silicic acid. This was the same effect as that which we now see in the effervescence of carbon dioxide produced when any free acid is dropped upon calcium carbonate.

The general investigation of the fluid-cavities is by no means exhausted, and it may lie within the reach of members of this Society to gather new facts which may throw great light upon the conditions of metamorphism to which the rocks and minerals inclosing such cavities were subjected.

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[15] Geol. of N. H., Vol. III., Pt. IV., p. 207.

TRICERATIUM DAVYANUM.

BY P. H. DUDLEY, C. E.

(*Read May 15th*, 1885.)

The following description of *Triceratium Davyanum*, Grev.,[1] was published by Dr. R. K. Greville in the "Quarterly Journal of Microscopical Science" in 1862 (See Vol. II., New Series, p. 232; and Pl. X., Fig. 4): "Valve with slightly convex sides, rounded angles, and large punctate pseudo-nodules; border and the central triangular space largely cellulate, the former divided into compartments by transverse lines. Distance between the angles, .0068 in. to .0080 in. There can be no question that, for beauty and interest, this magnificent species stands at the very head of the genus, distinguished, as it is, for many fine forms. The only two examples as yet known were both discovered by my acute and indefatigable friend, Mr. Johnson."

I have taken, in different focal planes, some photographs of side-views of the specimen of *Triceratium Davyanum* mounted by Mr. Febiger which was exhibited by our President at the meeting of May 1st. These will enable us to some degree to understand its sculpture without resorting to the expedient of making sections of a diatom which is so rare and so highly prized. They are direct reproductions, in printer's ink, of the negatives, and exhibit exactly the relation of all the parts as given by the microscope. They will be seen to furnish several important features not shown in Dr. Greville's engraving. They were taken with a lens of high power and high angle (N. A., 1.13), a homogeneous-immersion $\frac{1}{10}$th, my object being to limit the penetration so as not to show the entire convexity in one view, and so as to afford, besides, a basis of measurement. The magnification is four hundred and eight, linear.

In photograph No. 1 is shown the general appearance of the specimen when the markings in the pseudo-nodules, at the angles of the diatom, are in focus, the rim of those nodules rising apparently $\frac{1}{10,000}$th of an inch above the markings. In this view the secondary triangle, with its small, central nodule, is below the focal plane, and no areolation is seen bordering any part of the two blank spaces, resembling openings, which lie between the base of each pseudo-nodule and an apex of the secondary triangle.

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[1] "I have great pleasure," said Dr. Greville, "in dedicating this rare species to Dr. Davy, who collected and brought home the material in which it was discovered." The material was from the Barbadoes deposit.

In photograph No. 2 the focus is run in $\frac{2}{10,000}$ths of an inch below its position in No. 1. The central nodule is here distinct, and the longitudinal division of its radiating lines can also be seen. The general areolation seems less deep, the convexity is also reduced, and areolation becomes apparent below the base of each pseudo-nodule.

For photograph No. 3 the focus was run in $\frac{4}{10,000}$ths of an inch from No. 2, or $\frac{6}{10,000}$ths of an inch from No. 1. The apices of the secondary triangle, which Dr. Greville represents as plain are here seen to be areolated. The outer border of the diatom is not quite distinct, some convexity still existing. The depth of the entire convexity would seem to be less than $\frac{1}{1,000}$th of an inch. With the focus lowered about $\frac{2}{10,000}$ths of an inch further, the convexity disappeared, but no indication of a row of cells like that shown in Dr. Greville's illustration could be seen.

FORAMINIFERA FROM BERMUDA.

BY A. WOODWARD.

(*Presented May 15th*, 1885.)

In two gatherings of Foraminifera, one made by Mr. W. G. DeWitt in 1884, the other by Mr. J. F. Kemp in 1885, at six different localities in the Bermuda Islands, I have found forms representing eighty-nine species, belonging to thirty-seven genera. My list of these, given below, does not claim to be a complete catalogue of Bermuda Foraminifera. To such catalogue access to material from other localities and from greater depths would be necessary.

The Hinsen's Island gathering furnishes, it will be seen, the largest number of species. The forms are very perfect, and many of them, such as *Biloculina*, *Spiroloculina*, and *Miliolina*, are quite common. Hamilton Harbor yields fewer species, but the specimens, especially of *Orbiculina adunca* and *Orbitolites complanata*, are well preserved. The forms from the shell-sand of Shelly Bay, north shore, are not abundant, but are perfect and beautiful. Those from Somerset Island and Paget Beach are few, badly worn, and difficult to identify.

H. B. Brady, in his Report on the Foraminifera collected in the Challenger expedition, speaks of the wide variation of form embraced within the specific limits of *Paneroplis pertusus*, from the compressed planospiral shell of about three convolutions, to the thin outspread shell of the species *planatus*. These gradational forms are, I found, quite fully represented in this Bermuda material.

Explanation of abbreviations :

H. I.—Hinsen's Island, low tide.
H. H.—Hamilton Harbor, five fathoms.
S. B.—Shelly Bay.
Sh. B.—Shelly Bay, north shore.
S. I.—Somerset Island, shore sand.
P. B.—Paget Beach.
×—Habitat.
W. and J.—Walker and Jacob.
F. and M.—Fichtel and Moll.

J. and P.—Jones and Parker.
P. and J.—Parker and Jones.

Biloculina, d'Orbigny.	H. I.	H. H.	S. B.	Sh. B.	S. I.	P. B.
" *ringens*, Lamarck, sp.	×	×	×	×		
" *elongata*, d'Orbigny.	×	×		×		
" *tubulosa*, Costa.				×		
Spiroloculina, d'Orbigny.						
" *acutimargo*, Brady.	×	×				
" *antillarum*, d'Orbigny.	×					
" *crenata*, Karrer.	×	×				
" *excavata*, d'Orbigny.		×				
" *grata*, Terquem.	×	×				
" *limbata*, d'Orbigny.	×					
" *robusta*, Brady.	×		×			
" *tenuis*, Czjzek, sp.	×	×				
Miliolina, Williamson.						
" *bicornis*, W. and J., sp.	×	×	×	×		
" *cultrata*, Brady.				×		
" *agglutinans*, d'Orbigny, sp.			×			
" *alveoliniformis*, Brady.		×	×	×		
" *oblonga*, Montagu, sp.				×		
" *Parkeri*, Brady.	×		×			
" *pulchella*, d'Orbigny, sp.	×	×	×	×		
" *Linnæana*, d'Orbigny, sp.			×	×		
" *reticulata*, d'Orbigny, sp.	×	×	×	×		
" *seminulum*, Linné, sp.	×	×	×	×	×	×
" *tricarinata*, d'Orbigny, sp.	×	×			×	
" *gracilis*, d'Orbigny, sp.				×		
" *valvularis*, Reuss, sp.				×		
Nubecularia, Defrance.						
" *lucifuga*, Defrance.		×				
Articulina, d'Orbigny.						
" *lineata*, Brady.	×	×		×		
" *sagra*, d'Orbigny.	×			×		
" *sulcata*, Reuss.	×		×	×		
Vertebralina, d'Orbigny.						
" *striata*, d'Orbigny.	×	×		×		
Planispirina, Seguenza.						
" *celata*, Costa, sp.	×	×		×		

	H. I.	H. H.	S. B.	Sh. B.	S. I.	P. B.
Planispirina exigua, Brady.	×	×				
“ *communis*, Seguenza.	×		×		×	
Cornuspira, Schultz.						
“ *foliacea*, Philippi, sp.	×	×		×		
“ *involvens*, Reuss.	×			×	×	
Peneroplis, Montfort.						
“ *pertusus*, Forskal, sp.	×	×	×	×	×	×
“ “ var. LÆVIGATUS, Karrer.	×	×		×		
“ “ var. CARINATUS, d’Orbigny.	×	×		×		
“ “ var. CYLINDRACEUS, Lam., sp.			×	×		
“ “ var. ARIETINUS, Batsch, sp.				×		
“ “ var. PLANATUS, F. and M., sp.				×		
Orbiculina, Lamarck.						
“ *adunca*, F. and M., sp.	×	×	×	×	×	×
Orbitolites, Lamarck.						
“ *complanata*, Lamarck.	×	×	×	×	×	×
“ *duplex*, Carpenter (*macropora*, Ehrenberg, sp. ?)	×					
“ *marginalis*, Lamarck, sp.	×	×		×		
Alveolinina, d’Orbigny.						
“ *melo*, F. and M., sp.	×			×		
Haplostiche, Reuss.						
“ *Soldanii*, J. and P., sp.	×	×				
Textularia, Defrance.						
“ *Barrettii*, J. and P.	×					
“ *gramen*, d’Orbigny.		×				
“ *luculenta*, Brady.	×	×				
“ *trochus*, d’Orbigny.	×	×				
Bigenerina, d’Orbigny.						
“ *robusta* (sp. ?), Brady.		×	×			
Trochammina, P. and J.						
“ *trullissata*, Brady.	×					
Chrysalidina, d’Orbigny.						
“ *dimorpha*, Brady.		×				

	H. I.	H. H.	S. B.	Sh. B.	S. I.	P. B.
Valvulina, d'Orbigny.						
" *conica*, P. and J.	×			×		
Clavulina, d'Orbigny.						
" *communis*, d'Orbigny.	×		×	×		
" *cylindrica*, Hantken.	×	×	×			
" *Parisiensis*, d'Orbigny.	×	×	×	×		
" *angularis*, d'Orbigny.				×		×
Bolivina, d'Orbigny.						
" *dilatata*, Reuss.	×					
Nodosaria, Lamarck.						
" *comata*, Batsch, sp.	×					
" (*Dentilina*) *intercellularis*, Brady.	×					
" *mucronata*, Neugeboren, sp.	×			×		
" *radicula*, Linné, sp.	×					
" *hispida*, d'Orbigny.				×		
Frondicularia, Defrance.						
" *alata*, d'Orbigny.		×			×	
" *inæqualis*, Costa.	×					
Vaginulina, d'Orbigny.						
" *linearis*, Montagu, sp.	×					
Cristellaria, Lamarck.						
" *compressa*, d'Orbigny.	×	×		×		
" *Schloenbachi*, Reuss.	×			×		
" *cultrata*, Montfort, sp.				×		
Uvigerina, d'Orbigny.						
" *angulosa*, Williamson.		×				
" *porrecta*, Brady.		×		×		
Sagrina (d'Orbigny), P. and J.						
" *raphanus*, P. and J.	×			×		
Globigerina, d'Orbigny.						
" *bulloides*, d'Orbigny.	×			×		
Orbulina, d'Orbigny.						
" *universa*, d'Orbigny.	×		×	×		
Patellina, Williamson.						
" *corrugata*, Williamson.			×			
Cymbalopora, Hagenow.						
" (*Tretomphalus*) *bulloides*, d'Orbigny.	×					

	H. I.	H. H.	S. B.	Sh. B.	S. I.	P. B
Discorbina, P. and J.						
“ *rosacea*, d'Orbigny.	×	×	×			
“ *turbo*, d'Orbigny, sp.	×					
Truncatulina, d'Orbigny.						
“ *reticulata*, Czjzek, sp.	×					
“ *variabilis*, d'Orbigny, sp.				×		
Anomalina, d'Orbigny.						
“ *foveolata*, Brady.		×	×			
Carpenteria, Gray.						
“ *monticularis*, Carter.	×					
“ *proteiformis*, Goës.	×					
Pulvinulina, P. and J.						
“ *auricula*, F. and M., sp.					×	
Nonionina, d'Orbigny.						
“ *depressula*, W. and J., sp.	×		×			
“ *umblicata*, Montagu, sp.		×				
Amphistegina, d'Orbigny.						
“ *Lessonii*, d'Orbigny.		×	×	×	×	
Operculina, d'Orbigny.						
“ *ammonoides* (sp.?), Gronovius, sp.			×			

A NEW SYMBIOTIC INFUSORIAN.

BY DR. ALFRED C. STOKES.

(*Received May 23d*, 1885.)

The following animalcule, from a little *Sphagnum* swamp in this locality, is but one among many infusorial forms that crowd the waters, most of which are undescribed, and new to science. This especial one is presented here because of its unusual interest as furnishing an apparent example of so-called symbiosis. The chlorophyll corpuscles within the ectoplasm are so numerous that they are in contact, thus forming an almost continuous subcuticular layer. According to Brandt's doctrine of animal and vegetable commensalism, or double parasitism, these chlorophyll corpuscles, which are, I presume, subspherical, are not mere collections of pigmentary matter, but true unicellular algæ living a parasitic life so far as their position and their absorption of the excreted products of the host are concerned, and at the same time compelling that host to play the *rôle* of parasite in appropriating the products elaborated by the plants. The theory —the discovery, as its supporters call it—is a beautiful one, but one which, in the opinion of the writer, is hardly tenable when applied to the Infusoria, where it is claimed to be particularly applicable.

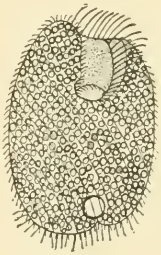

Fig. 1.

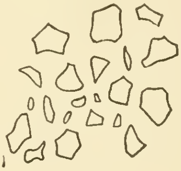

Fig. 2.

In the present example the subcuticular symbiotic algæ form, as stated, an almost continuous sheet of vivid-green corpuscles, as a rule completely obscuring the internal structure of the Infusorian. The endoplasm, however, is colorless and, when forced out by pressure, or when set free by diffluence after the creature's death, is seen to enclose numerous angular and colorless plates mingled with many smaller granules of similar character, the largest being perhaps two or three times the size of the presumably symbiotic algæ. These endoplasmic plates (Fig. 2) are flat, irregular, structureless, and somewhat refringent ; they are probably amylaceous. If, therefore, we may judge from the form, position, and arrangement of the chlorophyll corpuscles, they would seem to present an excellent example of symbiosis. But the statement is made that "The animals (Phytozoa, as they may be termed) renounce their independent life and allow themselves to be entirely supported by their parasites, when once the green or yellow algæ have entered their tissues and have multiplied there sufficiently. They absorb no more solid organic substances, although they are perfectly able to do so, but are entirely comparable, from the morphological point of view, to animals devoid of chlorophyll. This life of algæ in common with animals is one of the strangest things which can be conceived. Morphologically it is the algæ which are the parasites, but physiologically the animals."[1] So far as some, at least, of the Infusoria are concerned, the truth of this statement seems doubtful. The species which I have named *Leucophrys emarginata* is a case in point. The enclosed chlorophyll corpuscles, the symbiotic algæ, if they are such, could hardly be more abundant, unless the entire sarcode should be filled with them. They certainly appear to be sufficiently multiplied, yet the Infusorian is voracious. It gorges itself with diatoms. Small Infusoria are eagerly accepted, and, in one instance, I have witnessed the capture of a full-sized *Paramæcium aurelia*, Müll., which, although visible to the naked eye, was powerless to resist the current that swept it down the peristome-field and through the capacious oral aperture. The excrementitious matter forms a correspondingly large mass of empty diatom frustules, fragmentary remains and granules, surrounded by a colorless protoplasmic envelope.

The assertion that the green coloring matter of all these lower forms is symbiotic, it is equally difficult to accept. In several Infusoria the coloration is diffused, and not collected into granules, discs or spherules. A Vorticella described by the writer under the name of *V. smaragdina* is so tinted, the ectoplasm, and apparently the endoplasm as well, being translucent and homogeneous.

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[1] Jour. Roy. Mic. Soc., II. (1882), pp. 243-4.

The following is the description of the Infusorian referred to. It is shown in Fig. 1, under an amplification of about one hundred and sixty-five diameters.

Leucophrys emarginata, sp. nov. (Figs. 1 and 2).

Body pouch-shaped, depressed, about one and one-half times as long as broad, soft and flexible but persistent in form, the extremities subequal in width, the dorsal surface convex, the ventral flattened; the posterior extremity obliquely rounded, conspicuously emarginate at the left-hand side of the median line, the anterior obliquely truncate, deeply concave, the angles rounded, the right-hand border considerably prolonged beyond the frontal margin, the left-hand body-margin slightly flattened, the right-hand one convex; cuticular surface obliquely striate, minutely roughened; cuticular cilia fine, arranged in oblique longitudinal rows, those of the posterior extremity supplemented by numerous, longer, less rapidly vibrating hairs; peristome-field wide, deep, confined to the anterior third of the ventral surface, broadest anteriorly, the apical extremity rounded and curved toward the right-hand side, the dextral border straight, occasionally somewhat concave, overarching the deeply and laterally excavated peristome-field; oral aperture capacious, broadly ovate; endoplasm crowded with green, apparently disciform, chlorophyll corpuscles arranged somewhat regularly in oblique longitudinal lines; contractile vesicle single, spherical, postero-terminal, on the left-hand side of the median line; nucleus long, band-like, convolute, placed in the anterior body-half; anal aperture large, in close proximity to the contractile vesicle. Length of body $\frac{1}{150}$th of an inch. Habitat: marsh water, with *Sphagnum*.

The longer supplementary hairs clothing the posterior extremity and restricted to it, are from two to three times longer than those of the general surface. They appear to originate from the posterior striations, as do the shorter ones, and to have a less rapid and more independent movement.

TRENTON, N. J.

PROCEEDINGS.

MEETING OF MAY 1ST, 1885.

The President, Mr. C. Van Brunt, in the chair.

Twenty-five persons present.

Mr. J. C. Lathrop was elected an Active Member of the Society.

OBJECTS EXHIBITED.

1. *Triceratium Davyanum*, Greville, a rare and beautiful diatom, from Barbadoes deposit; mounted by Mr. C. Febiger: by C. VAN BRUNT.
2. *Navicula Sillimanorum*, from Crane Pond, Mass.; mounted by Mr. J. A. Bagley: by WALTER H. MEAD.
3. *Plumatella:* by A. D. BALEN.
4. *Closterium*, and *Nostoc:* by W. G. DE WITT.
5. Triungulin larva of the Narrow-necked Oil-beetle (*Meloë angusticollis*, Say), a parasite of *Anthophora:* by J. L. ZABRISKIE.
6. Zentmayer's Abbe Condenser: by C. S. SHULTZ.
7. Dynamo-Electric Machines, for use in microscopical illumination: by G. F. KUNZ.

TRIUNGULIN LARVA OF MELOE ANGUSTICOLLIS.

The Rev. J. L. Zabriskie: "The Oil-beetle (*Meloë angusticollis*, Say) takes its name from its habit of emitting an oily fluid from the joints of its legs. The insect is of a dark-blue color, has very short wing-covers, and a large, soft abdomen. It is remarkable for passing through seven stages of transformation; viz., the egg, the triungulin, or first larva, the second larva, the false pupa, the third larva, the pupa, the imago. The first larva is called triungulin because each foot looks as if it had three claws. What seems the middle claw is an enormously developed foot-pad. In form this larva resembles a louse. The three thoracic segments are nearly equal in size, flattened, transversely oblong, and in the back of the middle segment, near the median line, is the first pair of spiracles. The tip of the abdomen is furnished with two pairs of setæ, of which the inner is much longer than the outer. I captured my specimen on one of our native bees of the genus *Andrena*.

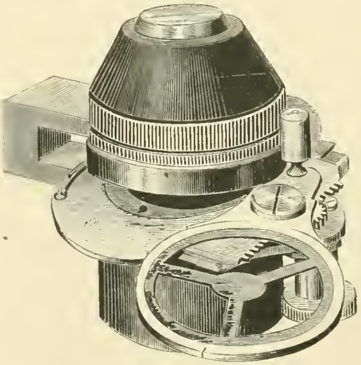
"The habits of *Meloë* have been fully described by Prof. C. V. Riley (See "American Naturalist," 1878, p. 216). He says, in effect: 'This insect lays more than three thousand eggs, depositing them in the ground. The triungulin larvæ are very active. Soon after hatching, they climb certain flowering plants and attach themselves to bees and flies which visit the flowers. All, however, are destined to perish excepting the few fortunate ones that are carried to the nest of the *Anthophora*, a honey-storing bee which tunnels for itself a habitation in the ground. The triungulin devours the egg of the bee. Moulting, and passing into the second and less active larval state, the insect feeds on the honey garnered by the bee.'"

Mr. Zabriskie exhibited also the imago, male and female, of *Meloë angusticollis*, and the Blister-beetles *Cantharis vesicatoria* and *Lytta marginata*, which are closely related to *Meloë*.

DYNAMO-ELECTRIC MACHINES.

Mr. G. F. Kunz exhibited two small dynamo-electric machines, one of which was operated by the foot, the other by the hand. They were loaned for the occasion by the Excelsior Electric Apparatus Company, of New York. Mr. Kunz said: "With the aid of a small gas engine or a small water motor, a dynamo-electric machine will produce a brighter and steadier light than can be obtained from a battery, and will produce it at less cost. For microscopical illumination it can be used with great advantage, especially in photography."

ZENTMAYER'S ABBE CONDENSER.



Mr. C. S. Shultz exhibited and described the Zentmayer Abbe

Condenser. It can be readily adapted to the substage of any microscope. The mounting is simple and light. The diaphragm-plate is easily manipulated.

MEETING OF MAY 15TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Thirty-seven persons present.

OBJECTS EXHIBITED.

1. Syenite from the Obelisk, Central Park ; shown by polarized light : by A. WOODWARD.

2. Foraminifera from Raine Island—one hundred and fifty forms, representing one hundred species, gathered from a depth of one hundred and fifty-five fathoms; prepared by Mr. Joseph Wright, of Belfast, Ireland : by A. WOODWARD.

3. Crystals containing cavities with Inclusions : by A. A. JULIEN. Among these were,—

(1) Topaz, granyte, and smoky quartz, showing cavities containing liquid carbonic acid gas and a bubble of the gas.

(2) Crystal of topaz, showing cavity containing brine with crystals of sodium chloride.

(3) Quartz with large cavity containing a movable globule of water.

(4) Artificially prepared crystals of sodium chloride clouded by cavities filled with solution of potassium dichromate.

4. Photographs, in different planes, of *Triceratium Davyanum* : by P. H. DUDLEY.

INCLUSIONS IN CRYSTAL.

Dr. A. A. Julien read a Paper entitled "The Sealed Flasks of Crystal." He treated particularly the inclusions found in smoky quartz. His Paper constitutes the first article in this Number of the JOURNAL.

PHOTOGRAPHS OF TRICERATIUM DAVYANUM.

Mr. P. H. Dudley exhibited and described three photographs of *Triceratium Davyanum* which, by representing the diatom as it appears when viewed in as many different focal planes, elucidate, in part, its sculpture. His description forms the second article in this Number of the JOURNAL.

FORAMINIFERA FROM BERMUDA.

Mr. A. Woodward stated that he had examined a large number of specimens of recent Foraminifera collected at Bermuda, and had fully identified among them nearly ninety species, representing thirty-seven genera. A list of these will be found in another part of this Number of the JOURNAL.

PROF. HAMILTON L. SMITH'S NEW MOUNTING MEDIUM.

President Van Brunt: "My remarks at the meetings of March 20th and April 3d respecting Prof. H. L. Smith's new medium for mounting were incomplete, and might create an impression that I consider this medium a failure. I wish to correct this impression by repeating what I then said, and by giving more fully the facts in regard to this discovery of Prof. Smith.

"The new medium is, as I stated, glycerine holding in solution a salt, or salts, giving a refractive index of about 1.8. By applying heat and expelling the water the index is raised still higher, and the medium is hardened to such a degree that diatoms or other forms do not move easily in it, even when free to move. I have slides in which the forms, mounted in this material thus hardened, cannot be made to move either by pressure or under the ordinary heat used in photography. Should the refractive index of the medium be reduced, for purposes of photography, by dilution with glycerine, large forms, such as Coscinodiscus and the larger Naviculæ, would be liable to move, especially if exposed to heat.

"It is not, however, necessary that any forms should be free to move in this medium. Diatoms may be fastened to the cover-glass by heat. I possess a slide of selected forms which were fastened to the cover in that way. It was prepared by Dr. Clapp, of Indiana. Fresh forms, from which the endochrome is burned out in this process, are found to adhere to the glass very strongly.

"Of other ways, of which there are many, of fixing objects to the cover-glass, I will give one which has been used very successfully in glycerine mounts,—the albumen method. Mix filtered or strained albumen and glycerine, in equal parts, and with a needle apply a thin film of the mixture to a surface of the cover-glass. On this film place the object. If, now, the albumen be coagulated by a gentle heat, it will hold the object so fast that it can be mounted in glycerine and will always keep its place. The albumen is transparent except when too much is used.

"For mounting objects which require a high refractive index, I consider Prof. Smith's new medium preferable to any other yet found. Even when diluted to a fluid consistency, it will not evaporate, and is easily confined by white-zinc cement. Whether it is permanent or not, time only can determine. Prof. Smith does not give his formula, and his reason for not doing so is that 'he does not wish to be premature in putting before the world another material that may prove a failure.' In the April Number of the "Journal of the Royal Microscopical Society" he is, I notice, taken to task for keeping secret the composition of his deep-yellow medium (2.4 refractive index). My impression is that he did give to his friends the formula of this preparation. I have known Prof. Smith many years, and I am sure that, if he should make an important discovery of this kind, he would not retain it as a trade secret."

PUBLICATIONS RECEIVED.

The Electrician and Electrical Engineer: Vol. IV., No. 41 (May, 1885) pp. 40.

Entomologica Americana: Vol. I., No. 2 (May, 1885); pp. 20.

Journal of Mycology: Vol. I., No. 1 (January, 1885); pp. 16. No. 2 (February, 1885); pp. 16. No. 3 (March, 1885); pp. 16. No. 4 (April, 1885); pp. 12. No. 5 (May, 1885); pp. 12.

Johns Hopkins University Circulars: Vol. IV., No. 39 (May, 1885); pp. 12.

Anthony's Photographic Bulletin: Vol. XVI., No 9 (May 9th, 1885); pp. 32. No. 10 (May 23d. 1885); pp. 32.

The American Monthly Microscopical Journal: Vol. VI., No. 5 (May, 1885); pp. 20.

The Microscope: Vol. V., No. 5 (May, 1885); pp. 24.

West-American Scientist: Vol. I., No. 6 (May, 1885); pp. 6.

The Midland Naturalist: Vol. VIII., No. 89 (May, 1885); pp. 28.

The Botanical Gazette: Vol. X., No. 5 (May, 1885); pp. 16.

Transactions of the Massachusetts Horticultural Society: 1884, Pt. I.; pp. 181.

Bulletin of the Torrey Botanical Club: Vol. XII., No. 4 (April, 1885); pp. 12.

Proceedings of the Natural Science Association of Staten Island: May 9th, 1885; p. 1.

INDEX TO ARTICLES OF INTEREST TO MICROSCOPISTS WHICH HAVE RECENTLY APPEARED IN OTHER JOURNALS.

Amphipoda, The Urinary Organs of the: W. Baldwin Spencer.
Quar. Jour. Mic. Sci., XXV. (1885), pp. 183–91 (5 figs.).

Apothecium, Structure of the, in *Solorina*.
Cole's Studies in Mic. Sci., III. (1885), pp 13–6 (colored plate).

Athyrium Filix-fœmina. See Lady-Fern.

Athyrium Filix-fœmina, var. *clarissima*, Further Notes on a singular Mode of Reproduction in: Charles T. Druery.
Jour. Linn. Soc. Lond. (Bot.), XXI. (1885), pp. 358–60 (2 figs.).

Bacteria, Koch's Method of Isolating and Cultivating, as used in the Laboratory of the Bureau of Animal Industry, Dept. Agriculture: Drs. D. E. Salmon and Theobald Smith.
Am. Mon. Mic. Jour., VI. (1885), pp. 81–4.

Bacteria, Mounting. See Staining, Microscopical.

Cercosporæ, Enumeration of the North American, with Descriptions of the Species: J. B. Ellis and Benjamin M. Everhart.
Jour. of Mycology, I. (1885), pp 17–24; 33–40; 49–56; 61–67.

Choanoflagellata. See Sponges.

Collodion, The Uses of: C. O. WHITMAN.
Am. Nat., XIX. (1885), pp. 626–8.

Echinus, Transverse Section of Spine of; under heading Graphic Microscopy: E. T. D.
Sci.-Gos., 1885, pp. 97–98 (colored plate).

Embryology, Outlines of (Fourth paper). Metameric Segmentation.
The Microscope, V. (1885), pp. 107–12 (4 figs.).

Ferns, On Apospory in (with special reference to Mr. Charles T. Druery's Observations): F. O. BOWER.
Jour. Linn. Soc. Lond. (Bot.), XXI. (1885), pp. 360–8 (4 diags., 12 figs.).

Gill-book of *Limulus*. See *Scorpio*.

Halicryptus. See *Priapulus*.

Heterœcious Uredines, Remarks on the Reproduction of the: CHARLES B. PLOWRIGHT.
Jour. Linn. Soc. Lond. (Bot.), XXI. (1885), pp. 368–70.

Insects, The Eye and Optic Tract of: SYDNEY J. HICKSON.
Quar. Jour. Mic. Sci., XXV. (1885), pp. 215–51 (35 figs.).

Lady-Fern (*Athyrium Filix-fœmina*), Observations on a singular Mode of Development in the: CHARLES T. DRUERY.
Jour. Linn. Soc. Lond. (Bot.), XXI. (1885), pp. 354–7.

Lantern Transparencies: C. M. VORCE.
Am. Mon. Mic. Jour., VI. (1885), pp. 84–5.

Limulus, Gill book of. See *Scorpio*.

Liquidambar Styraciflua, or American Storax, the Gum of, as a Mounting Medium: A. B. AUBERT.
Am. Mon. Mic. Jour., VI. (1885), pp. 86–7.

Loxosoma, On the Structure and Development of: SIDNEY F. HARMER.
Quar. Jour. Mic. Sci., XXV. (1885), pp. 261–337 (62 figs.).

Lung-book of *Scorpio*. See *Scorpio*.

Microspectroscope, The: A. Y. MOORE.
The Microscope, V. (1885), pp. 101–6 (15 figs.).

Priapulus and *Halicryptus*, On the Skin and Nervous System of: ROBERT SCHARFF.
Quar. Jour. Mic. Sci., XXV. (1885), pp. 193–213 (12 figs.).

Ramularia obovata, Fckl.: J. B. ELLIS and BENJAMIN M. EVERHART.
Jour. of Mycology, I. (1885), pp. 69–70.

Rocks, The Microscopical Study of: JOHN ERNEST ADY.
Ill. Sci. Mon., III. (1885), pp. 131–3 (2 figs.).

Scorpio, A New Hypothesis as to the Relationship of the Lung-book of, to the Gill-book of *Limulus*: E. RAY LANKESTER.
Quar. Jour. Mic. Sci., XXV. (1885), pp. 339–42.

Scutigera coleoptrata (one of the Myriapoda), On a Peculiar Sense Organ in: F. G. HEATHCOTE.
Quar. Jour. Mic. Sci., XXV. (1885), pp. 253–60 (9 figs.).

Section Cutting, Notes on: E. L. MARK.
Am. Nat., XIX. (1885), pp. 628–31.

Segmentation, Metameric. See Embryology, Outlines of.

Solorina crocea. See Apothecium.

Sponges, On the Relationship of the, to the Choanoflagellata: FRANZ EILHARD SCHULZE.
Ann. and Mag. Nat. His., IV. (1885), pp. 365–77.

Staining, Microscopical—Mounting Bacteria: F. GRANT.
Eng. Mech., XLI. (1885), pp. 212–4.

Staining Tissues in Microscopy (II.) (HANS GIERKE, *Zeitschr. für Wiss. Mic.*): Translated by W. H. SEAMAN.
Am. Mon. Mic. Jour., VI. (1885), pp. 89–94.

Storax, American. See *Liquidamber Styraciflua*.

Vorticellæ, A Key to the: ALFRED C. STOKES.
The Microscope, V. (1885), pp. 97–101 (8 figs.).

MISCELLANEA.

THE AMERICAN SOCIETY OF MICROSCOPISTS.—Prof. H. L. Smith, President of the American Society of Microscopists, announces that the Eighth Annual Meeting of the Society will be held at Cleveland, O., beginning on Tuesday, August 18th, 1885, and lasting four days. He urges members to bring to the meeting the choice products of the past year's investigations. He requests that titles and abstracts of papers be sent as soon as practicable to the Secretary, Prof. D. S. Kellicott, Ph.D., 119 Fourteenth-street, Buffalo, N. Y., and that all persons who intend to be present, or to join the Society, inform him or the local committee at Cleveland of their intention. "The value of the organization," continues Prof. Smith, "has been established, and we are full of hopeful expectation that all the working microscopists of the country will join its membership and make it the centre of active microscopical investigation and the means of mutual stimulus to better and higher scientific work. * * The arrangements made by the local committees are such as to ensure most agreeable and interesting sessions, with the most ample facilities for those who present papers to illustrate them by projection apparatus and otherwise. * * Each year shows more plainly the importance of having the papers which may be read, so prepared that they may be left with the Secretary at the close of the meeting, and that the publication of the Proceedings shall not be delayed by revisions of manuscript or for the preparation of drawings. * * The session for illustration of practical work in preparing and mounting objects, which proved so fascinating and useful a feature of the Chicago and Rochester meetings, will be still more varied and instructive than before. Mr. C. M. Vorce, Cleveland, has charge of the preparations for the working session."

LEUCOPHRYS EMARGINATA.—Dr. Alfred C. Stokes's illustrated article descriptive of a new species of infusorian which he names *Leucophrys emarginata* furnishes an example of careful observation. A feature of great interest in the article is the discussion of the bearing of the structure and habits of this infusorian on Brandt's doctrine of reciprocal parasitism. The author's views on this point are clearly presented, and they appear just.

AMPHIPLEURA PELLUCIDA AND THE DIFFRACTION THEORY. —The photographs of this diatom recently made by Dr. Van Heurck have given rise to some discussion, and some of those who do not admit the reality of the beaded appearance shown by the photographs, claim to rest their view on the Abbe diffraction theory.

This shows that some misconception exists as to the application of the theory, which does not establish, as supposed, that all appearances of minute structure with high powers are wholly illusory and do not correspond to any physical structure. On the contrary, the images shown by the microscope are all, in fact, caused by real structural peculiarities of the object observed. Thus in the case of the "beads" of *A. pellucida*, the existence of such an image proves that the diatom has not merely a periodic differention of structure in one direction, but that such differentiation exists in two directions which cross at right angles.

What the diffraction theory shows is that the *real* form and structure of the beads cannot be determined by the mere inspection through the microscope of their images. The microscope leaves wholly undecided the question whether they are elevations, or depressions, or simple centres of thickening in the substance of the valve, resulting, it may be, from the intersection of two siliceous layers, the densities of which vary periodically.—*Jour. Roy. Mic. Soc.*, 1885, p. 529.

"OMNIS NUCLEUS E NUCLEO."—It is nuclein that fertilizes. Sperm-cell may unite with germ-cell, but there is no further development unless the nuclei of the two cells combine. The nucleus is regarded as a more highly organized substance than protoplasm, and as representing a special centre of force in the cell.—DR. O. HERTWIG. See *Jour. Roy. Mic. Soc.*, 1885, pp. 421–423.

ARTIFICIAL DIVISION OF INFUSORIA.—Prof. M. Nussbaum and, independently, Dr. A. Gruber have obtained some interesting results as to the regeneration of unicellular organisms. The former divided an *Oxytricha* into halves either longitudinally or transversely and found that the two halves soon became normal animals, and that the complete organisms thus formed developed again by spontaneous division. If the artificial division be into unequal parts, these parts grow again, except those which are without a nucleus; so that a nucleus seems to be essential to the retention of the regenerative power of a cell.

Dr. Gruber experimented in a similar manner upon *Stentor cœruleus.* He observed that when this infusorian was divided transversely through the centre, the posterior section in twelve hours developed a new peristome-area with the large cilia and the oral spiral. The part containing the mouth also added a new posterior portion. A longitudinal division through the peristome was followed by the same regenerative process, two complete peristomes being again formed.—See *Jour. Roy. Mic. Soc.*, 1885, p. 472.

Choice of Objectives and Oculars.—Though objectives of very high power are occasionally made, even $\frac{1}{100}$th-inch focus being announced, the larger and more conservative portion of microscopists evidently incline, as they always have done, toward a much more moderate limit. It is probably quite safe to say that objectives anywhere from $\frac{1}{5}$th to $\frac{1}{12}$th-inch, if not lower, can now be obtained which will show, as well as has ever been done, anything that has yet been seen by the microscope.

The question as to the choice of moderate or extreme apertures for objectives is still open, and somewhat evenly disputed. Dr. Carpenter and a large following of conservative judges still hold to the former view—not doubting the value of large aperture, but believing that it should accompany higher powers, and that to a 1-inch, for instance, should not be assigned the aperture and work of a $\frac{1}{4}$th, nor to a $\frac{4}{10}$ths that of a $\frac{1}{5}$th; and this view is corroborated by the mathematical computations of the relation of aperture to power by Prof. Abbe (J. R. M. S., 1883, p. 790). On the other hand, a large number of experienced persons prefer large angles even for biological work, some claiming that the highest attainable angles are the best for all uses and powers.

In the combining of oculars with objectives, it is still undecided whether it is preferable to secure a sufficient variety of powers by means of a large number of objectives, or by the high and low eye-piecing of a few. Dr. Carpenter prefers the 2-inch, and would use even the 1-inch for exceptional purposes. Prof. Abbe selects $\frac{2}{3}$ds-inch (× 15) as the highest really useful ocular. —R. H. Ward, M. D. *Appleton's Annual Cyclopedia for* 1884: Article, *Microscopy.*

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ON CERTAIN SO-CALLED PRODIGIES.

BY C. F. COX.

(*Read June 5th*, 1885.)

The "American Monthly Microscopical Journal" published, in February last, a newspaper clipping giving the dates of various reputed "colored rains." That list, the work of an anonymous compiler, is manifestly only a fragment of what might be made by a diligent searcher of chronicles and histories; for mysterious natural phenomena have always been objects of more or less superstitious attention and have been prominent subjects of written record from the earliest historical times.

To the student and philosopher of to-day the annals of the so-called prodigies of earlier ages have a certain interest and value, because they furnish landmarks in the progress of accurate observation and give us clues to that credulous state of the human mind which seems to have necessarily preceded the foundation of inductive reasoning. Besides this, however, the mere historian of scientific discovery will find in these ancient records what we must believe to be truthful statements of facts mingled with distorted and erroneous interpretations and many unintentional misstatements of what were thought to be facts; and he may, not altogether unprofitably, exercise his ingenuity in and apply his later knowledge to the separation of the true from the false, and the elucidation of that which has seemed obscure.

In this view of the matter, I have thought that I might venture to enlarge the list of such old-time prodigies as would naturally interest persons accustomed to the use of the microscope; by which I mean such marvels and wonders as would not now seem to be extraordinary or prodigious, because of the light which microscopical investigation would be able to throw upon them.

I find myself speaking of these prodigies as if they were occurrences peculiar to ancient times, while the fact is that neither the occurrences themselves, nor the superstitious and ignorant conditions of mind which attributed to them supernatural origins and saw in them miraculous portents, have been entirely wanting in any generation,—not even our own. Indeed, since I have become interested in this subject, I have taken to cutting from the newspapers of the day, and pasting into the back of one of my very old chronicles of prodigies and monsters, all accounts I have happened upon of wonders in nature approaching in character to those recorded in the musty volume thus turned to scrap-book purposes ; and already I have constructed a striking and startling parallelism both in matter and in spirit.

But not only has there existed a sort of fetichism and a crude worship of natural phenomena in every age of the world, but there has persisted in every race and people something of the taint imparted to the first of mankind by the father of lies, so that when it comes to merely reporting the bare facts of any case which is somewhat obscure or uncommon in character, ordinary human testimony is hardly to be trusted ; for mysticism and imagination are found to have taken the place of sober sense and scientific scrutiny. We all know how difficult it is now-a-days to obtain from intelligent spectators, of general truthfulness, absolutely veracious accounts of so-called spirit manifestations or even of the confessed tricks of clever conjurers. What wonder, then, if the people of centuries ago mixed fiction with fact when attempting to record their impressions of the awe-inspiring operations of the elements ?

As the world whirls on and the sum of human knowledge increases, there is more and more appropriateness in the words of Plutarch,—" As geographers thrust into the extremities of their maps those countries that are unknown to them, remarking at the same time that all beyond is hills of sand and haunts of wild beasts, frozen seas, marshes and mountains that are inaccessible to human courage or industry ; so, in comparing the lives of illustrious men, when I have passed through those periods of time which may be described with probability, and where history may find firm footing in facts, I may say of the remoter ages, that all beyond is full of prodigy and fiction, the region of poets and fabulists, wrapt in clouds, and unworthy of belief." [1]

In ancient Rome every phenomenon of a character to inspire awe or alarm was looked upon as a miracle of important meaning, designed by the gods as a warning of coming events or as a penalty for some past sin of omission or commission. Accordingly the national religion provided means both for ascertaining the portents of prodigies and for satisfying their supposed requirements. The senate took official notice of thunder-storms, freshets, inundations, earthquakes, eclipses, comets, meteors, hail-storms, and unusual showers of every kind, of the flights of birds, the movements of wild beasts, the actions of domestic animals, of the births of monsters and deformities, both brute and human, and even of various palpably fictitious events founded in mere rumor ; and matters so trifling and insignificant that they seem to us simply ridiculous,—as, for example, the varying appetites and dispositions of certain sacred chickens,—were made subjects of solicitous observation and of grave consideration. Upon information of the occurrence of any prodigy in any part of the empire, the Sibylline Books, or Books of the Fates, were solemnly consulted by the priestly officers having the charge of them, and, in accordance with their interpretations and directions, such supplications and sacrifices were decreed as seemed necessary to appease the gods and to expiate supposed faults or to secure desired favors.

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[1] Life of Theseus. Laughorn's translation.

In such a state of society not only were prodigies likely to occur, but, as Livy the historian remarks (Bk XXI., Ch. LXII.),[2] "as is not unusual when people's minds have once taken a turn towards superstition, many were reported and credulously admitted"—which perhaps had no basis in fact. In another place (Bk. XXIV., Ch. X.) Livy says, "Numerous prodigies were reported to have happened this year [Y. R. 538 : B. C. 214], and the more these were credited by simple and superstitious people, the more such stories multiplied." And in one instance he confidently asserts that "several deceptions of the eyes and ears were credited as facts" (Bk. XXIV., Ch. XLIV.). Still later he remarks that there "arose abundance of superstitious notions, and the minds of the people became disposed both to believe and to propagate accounts of prodigies, of which a great number were reported" (Bk. XXIX., Ch. XIV.).

At last, however, he seems to have felt it incumbent on him to declare a kind of neutrality in what we may believe to have been a controversy going on in his day, something like the conflict between science and theology supposed to have been waged at later periods : for he says : "I am well aware that, through the same disregard of religion which has led men into the present prevailing opinion, of the gods never giving portents of any future events, no prodigies are now either reported to government or recorded in histories. But, for my part, while I am writing the transactions of ancient times, my sentiments, I know not how, become antique, and I feel a kind of religious awe which compels me to consider that events which the men of those days, renowned for wisdom, judged deserving of the attention of the state and of public expiation, must certainly be worthy of a place in my history" (Bk. XLIII., Ch. XIII.).

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[2] Baker's translation.

Somewhat in the same strain of half skepticism and half apology is the passage in Plutarch's Life of Coriolanus, which says : "Indeed, we will not deny that images may have sweated, may have been covered with tears, and emitted drops like blood. For wood and stone often contract a scurf and mouldiness that produces moisture; and they not only exhibit many different colours themselves, but receive variety of tinctures from the ambient air : at the same time there is no reason why the Deity may not make use of these signs to announce things to come. It is also very possible that a sound like that of a sigh or a groan may proceed from a statue, by the rupture or violent separation of some of the interior parts; but that an articulate voice and expression so clear, so full and perfect, should fall from a thing inanimate, is out of all the bounds of possibility; for neither the soul of man, nor even God himself, can utter vocal sounds, and pronounce words, without an organized body and parts fitted for utterance. Wherever, then, history asserts such things, and bears us down with the testimony of many credible witnesses, we must conclude that some impression not unlike that of sense influenced the imagination and produced the belief of a real sensation; as in sleep we seem to hear what we hear not, and to see what we do not see."

Notwithstanding this rather just canon of criticism, Plutarch does not refuse to repeat, and apparently to endorse, those accounts of prodigies which had come down to him in histories and other writings, particularly the stories derived from Livy. Thus, besides many other such marvels, he mentions, in his Life of Romulus, that it rained blood in Rome ; in the Life of Camillus, that images have often sweated; in the Life of Timoleon, that the face of an image dropped with sweat; in the Life of Marcellus, that the river which runs through the Picene was seen flowing with blood; in his Life of Alexander, that the statue of Orpheus in Libethra, which was of cypress wood, was in a profuse sweat for several days; in the Life of Antony, that Antony's statue in Alba was covered with sweat for many days, which returned though it was frequently wiped off; and, in his Life of Brutus, that the arm of one of the officers sweated oil of roses, which would not cease though they often wiped it off.

To these statements of Plutarch I may appropriately append his further explanation of his philosophical position, given in these words: "Many such accounts we have from our ancients, and not a few persons of our own time have given us wonderful relations, not unworthy of notice. But to give entire credit to them, or altogether to disbelieve them, is equally dangerous, on account of human weakness. We keep not always within the bounds of reason, nor are masters of our minds; sometimes we fall into vain superstition, and sometimes into an impious neglect of all religion. It is best to be cautious, and to avoid extremes." [3]

Keeping this admonition of Plutarch's in mind, we may profitably explore the ancient chronicles for matters both curious and interesting.

It appears to me that the Romans were the most superstitious of the civilized nations of antiquity, and that Livy has given more prominence and attached more importance to prodigies than any other author professing merely historical writing. In his History of Rome I find that he records *showers of earth* as occurring six times,—B.C. 295, 194, 192, 190, 172, and 167. He also mentions a *shower of chalk* as happening in the year 214 B.C. From him we learn that, in B.C. 217, the statue of Mars on the Appian Road, and the images of the wolves, *sweated;* that, in 206 B.C., a profuse sweat flowed from the Altar of Neptune, in the Flaminian circus; that, in B.C. 181, the image of Juno Sospita, at Lanuvium, *shed tears;* and that, in the year 169 B.C., the image of Apollo, in the citadel at

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[3] Life of Camillus.

Cumæ, shed tears during three days and three nights. A *shower of milk* is said by him to have fallen in Sinuessa in B.C. 209; and he reports that a *stream of milk* flowed in the river at Ariminum, in the year 194 B.C. Marvellous appearances of blood, in one form or another, are subjects of frequent record. Thus, in 217 B. C., two shields, in Sardinia, are said to have *sweated blood;* in the same year, in Antium, and again in B.C. 206, in the same place, reapers discovered the ears of corn to be bloody as they gathered them. In the year 217 B. C., at Cære, streams of water were mixed with blood, and the Fountain of Hercules was tinged with bloody spots; in 214 a stagnating piece of water, caused by the overflowing of the River Mincius, in Mantua, appeared as of blood; in 213 the river flowed in streams of blood at Amiternum; in 209 water flowed in a bloody stream at Alba; and in 207 a stream of blood flowed in at one of the gates of Minturna. *Showers of blood* are reported as having occurred: in B.C. 214, in the cattle-market, in the Istrian street, in Rome; in 194, in the Forum, Comitium, and Capitol; in 183, for two days, in the area of Vulcan's temple; in 181, in the courts of the temples of Vulcan and Concord; in 172, during three successive days, in Saturnia; and in B.C. 169, at Rome, in the middle of the day. And in 167 B.C., we are told, Marcus Valerius, a Roman citizen, in Calatia, reported that blood had flowed from his hearth during three days and two nights.

I find in Livy but one reference to a *shower of flesh.* It is said to have occurred in the year of the City 293, or B.C. 459, and is recorded in these words: "Among other prodigies, a shower of flesh fell, which, as was reported, was in a great measure intercepted in its fall by a vast number of birds flying about the place, and what escaped them lay scattered on the ground for several days, without any degree of putrefaction, or being even changed in smell. The books were consulted by the duumviri presiding over sacred rites, and it was predicted that dangers impended from a concourse of foreigners; that an attack was to be made on the higher parts of the city, and lives lost in consequence;" &c., &c.

Pliny, in his Natural History, refers to this same prodigy in the following passage: "We finde recorded in monuments that it rained milke and bloud, when M. Acilius and C. Porcius were

Consuls. And many times else besides it rained flesh, as namely whiles L. Volumnius and Serv. Sulpitius were Consuls; and look what of it the foules of the aire caught not up nor carried away, it never putrified" (Bk. II., Ch. LVI.).[4]

Other than this, Pliny's records of prodigies are meagre and vague, being confined to a reported shower of so-called iron, a fall of wool, and a rain of "tyles and bricks." In the quotation made from him above, as well as in that from Livy, it will be found to be of importance to note the connection between the shower of flesh and the presence of a flock of birds, this being one of the instances in which ancient records of prodigies carry with them their own probable explanation.

The shower of flesh referred to by Livy and Pliny is mentioned also in a rare and curious illustrated Chronicle of Prodigies and Monsters compiled by Conrad Wolffhart (or Lycosthenes), and published in Latin at Basle in 1557, in which is incorporated all that is known of a work "*De Prodigiis*," by Julius Obsequens, a Roman writer in the time of Augustus. In this chronicle of Wolffhart's (of a copy of which I am the fortunate owner) occur also the only other records of descents of flesh known to me, except the somewhat notorious "Kentucky meat-shower" of 1875. The first of those other cases is said to have occurred in Liguria in 1456, A. D., and the last in France in 1552. As this would have been in Wolffhart's own life-time we should naturally expect from him some particulars, but he furnishes only the bald statement, "*in Francia sanguine & carne pluit.*"

Wolffhart's Chronicle is a rich mine of astonishing things, from which I shall endeavor to summarize briefly his accounts of the matters in which we are specially interested, after eliminating those which he quotes from Livy and which we have already considered. Like other writers upon prodigies, he records showers of earth (in the years 163, 160, and 131, B.C.), a shower of chalk (B.C. 96), a fall of stones and shells (B.C. 89), a rain of mud (B.C. 100), and one of ashes (A.D. 744). He also describes many wonderful meteoric showers and numerous miraculous falls of manna and other edible substances, which might perhaps fairly engage our attention if the limit of our time would permit. His references to showers of milk are remarkably numerous. These he records as having taken place in the years B.C. 272, 265, 263, 160, 127, 122, 116, 114, twice in 106, in two different places in 104, also at two places in 102, in 93 and in 90. In the year 122 B.C. a fall of oil and milk together is said to have occurred. He tells us also that in B.C. 131 streams of milk flowed into a cistern in Rome; that in the year 102 B.C. streams of milk sprang up gushing from the earth; and that in the year 41 B.C. the ditches ran with milk.

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[4] Philemon Holland's translation.

With other chroniclers, Wolffhart mentions the sweating of images and other like objects, and also informs us of statues that dripped with blood. Thus, a stone effigy of Antony, in Alba, emitted much blood in the year 41 B.C., and blood trickled from the big toe of a statue of Jupiter in the same place, the year before. In the year 131 B.C., he says, a new shield was spotted with blood; but he does not tell us whether the blood was supposed to have fallen upon it or to have exuded from it. In B.C. 204 the grain in the fields of Tarracina was found to be spotted with blood. Blood dropped from bread, or appeared upon it, in the years B.C. 332 and 89, and A.D. 583 and 1163. In A.D. 1093 bread that had been baked under ashes was stained as if with blood; and in 1550 it is said that when some soldiers were cutting bread with a knife drops of blood trickled from it and the whole interior was discovered to be full of it.

Blood is reported to have flowed or trickled from the earth in the years B.C. 263, 208, 163, 144, 140, 94, 92, 91, and 40, and in A.D. 782 and 940. On one of these occasions it is said to have clotted, on another to have flowed in a torrent, and once to have continued running for several days.

Blood is said to have flowed from, or to have bubbled up in, natural springs in B.C. 272 and in A.D. 1549, 1550, and 1555. These latter events having occurred in what were modern times to Wolffhart, are given with more than his usual particularity. That of 1550 is referred to a meadow in Saxony, and it is said of the blood which bubbled up that if a little were taken in the hand it turned a light yellow. The occurrences of 1555 are located at Vinaria and are set down to specific dates, as, for example, June 6th and the two days following; also June 12th and 13th.

Artificial fountains are also reputed to have flowed with blood, or to have had their waters mixed with it, the wonder lasting on one of these occasions for twenty-five days. The years in which these things are supposed to have happened are B.C. 340, 263, and 133, and A.D. 570, 935, 1002, 1010, 1163, and 1555.

Streams of water are said to have been changed into or tinged with blood in B.C. 459, 332, 234, 221, and 90. The River Danube is reported to have emitted a bloody torrent in A.D. 1349, which would seem to have been at a sufficiently late time to warrant our expecting some sort of careful observation of the phenomenon, whatever it really was.

We are told that in B.C. 205 and in A.D. 1552 a lake and a pond flowed with blood ; that in A.D. 53, for several days, the ocean on the coast of Britain rolled up blood ; and that in the time of the Emperor Nero (A.D. 66) the sea on the shores of Italy had the appearance of blood, while impressions of human forms were left on the sands.

Finally, Wolffhart makes mention of showers of blood which occurred in B.C. 178, 163, 131, 125, 104, 102, 100, 43, 35, and 28, and in A.D. 48, 541, 570, 782, 1114, 1120, 1163, 1165, 1274, 1337 1349, 1456, 1531, 1539, 1542, 1553, 1555, and 1556. Some others he describes with more detail. For instance, in B.C. 214 there was a fall of stones with much blood. In B.C. 110 it rained milk and blood together. In A.D. 541 real blood dropped from the clouds upon men's clothes. In A.D. 864 there was a fall of bloody snow. In A.D. 874 it rained blood for three days and three nights, at Brixia, Italy. In 1147 and 1555 there were descents of great numbers of butterflies sprinkled with blood, and as if it rained blood with them. In 1551 a bloody wisp was seen in the sky accompanied with a shower of blood, at Lisbon ; and in A.D. 570, and again in 1104, a fierce battle was seen to rage in the heavens, from which blood fell to the earth.

It is natural enough that in early times accounts of prodigious and marvellous occurrences should have been published principally for the entertainment and edification of the simple-minded and ignorant *vulgus*. Hence there have been printed at various times numerous catch-penny chapbooks, composed of compilations of awe-inspiring annals and traditions. One of the most prolific authors of this class of pseudo-historical literature was one Robert Burton, a resident of London, who, towards the close of the seventeenth century, produced nearly a dozen of what his publisher, with excusable partiality, called "very useful, pleasant and necessary books," to be sold at a shilling each. One of these works is entitled "The Surprising Miracles of Nature and Art," &c.; and another, "Admirable Curiosities, Rarities, and Wonders in England, Scotland and Ireland," &c. As the author himself states, the events of which he treats are given "as they are recorded by the most authentick and credible historians of former and latter ages," and I therefore think we may take their accounts as at least indicating the common belief as to the frequent occurrence of certain prodigies down to the beginning of the eighteenth century. In quoting from Burton I shall endeavor to omit those matters which have been already referred to in quotations from more ancient authors, though this is not always an easy point to determine, owing to the general carelessness and uncertainty as to dates in early writers and the varying systems of chronology employed by them.

In common with other chroniclers, Burton records cases of miraculous sweating and weeping of crosses, images, etc., which are not worth repetition here. We may also for the present pass over the reports of the descent of corn and other articles of food from the sky. The wonders which particularly interest us are the following: In A.D. 50, "in and about the coasts of England, for certain days, the sea seemed as blood;" and in A.D. 63 "the ocean seemed to be blood." In A.D. 81 it rained blood in Germany. In 323 a fountain ran with oil in Italy. In 434 it rained blood in Savoy. In 529 it rained blood for four days together in Piedmont. In A.D. 570, "at York, in England, the fountains ran blood; likewise blood fell from the clouds in Lombardy." In 639 it rained blood in Naples. In 688 it rained blood for seven days "throughout all Britain," and in the same year milk, cheese, and butter were reported to have been turned into blood. In 735 it rained oil in Spain. In 778 it rained blood, as well as earth and ashes, in Rome. In 808 it rained blood in Holland. In 1022 it rained milk in Rome, and a fountain of water in Lorrain was turned into blood. In 1100 a well in Finchamsted, Barkshire, England, "boiled up with streams of blood and continued so fifteen days together, and the waters discoloured all others where they came." In 1198, and again in 1378, it rained blood in England. In 1399 in a little town in Bedfordshire "it rained blood, the red drops whereof appeared in sheets hung out to dry." In 1618 and again in December, 1619, the water which runs through the city of Sixto, in Hungary, was turned into blood, and the ice therein was also blood-red. In the same year the water in a ditch in Vienna appeared like blood "for the space of eight days." In 1620, in Poland, it rained blood so abundantly that "the drops fell very fast from the tops of the houses." In 1622, in Darmstadt, trees were found the leaves of which dropped blood. On the 16th of July, 1622, in Wittenburg, it rained blood on the hands and clothes of the laboring men and likewise upon trees, stones, etc. In 1623 a well in Bohemia was for some days turned into blood; and in the same year, in Tursin, "the table, chairs and walls of the parlour of a citizen's house all sweated blood so that it began to run along the room," while in the towns of Mayenfield and Maylantz the sickles and the hands of the laborers, as they were mowing in the fields, were seen to be bloody. In 1624 it rained blood at Weinsham, in Bohemia, and at Friburg, in Silesia. In May, 1631, the water was turned into blood at Hall, in Lower Saxony; "and about the middle of this month this town was taken by Tilly * * and whilst his army lay in the town one of his chief officers saw blood prodigiously dropping from the house wherein he lay." In 1632, in Franestein (near Dresden), a woman who had bought some bread and carried it home was surprised, when she came to cut it, to see blood issue from it. In 1633, at Dobenshutz, in Althenburg, "blood sprang out of a fish-pond with such a filthy savour that if it were touched they could not wash off the stink in two or three days." In 1634 it rained blood and brimstone at Berlin. In November, 1635, in Holstein, "it rained thick blood whose drops being used as ink represented true natural blood in writing." In Isenach, in 1637, the conduit, situated in the market-place, "instead of water suddenly poured out blood, and so continued for two hours." At Weimar, in 1637, the water was turned to blood. In 1640 "a pond in Cambridge became red as blood, the water whereof being taken up in basons remained still of the same colour," and at Bencastle, in Northumberland, England, it rained blood, which "covered the church and churchyard." In May, 1646, it rained brimstone at Wittenburg. And, finally, in June, 1653, "a black cloud was seen over the town of Pool, in Dorsetshire, and soon after dissolved into a shower of blood which fell warm upon men's hands, and some green leaves with those drops upon them were sent to London and seen by many."

In the third chapter of the Rev. Dr. Hugh Macmillan's very charming little book entitled "First Forms of Vegetation," you will find accounts of many such prodigies as those to which I have just called your attention, and some of them are much more extraordinary than any which I have cited. His scientific explanations, too, are no less interesting than his merely historical quotations, and you will oblige me if you will supplement this paper with a perusal of his fascinating pages. I have not, I think, mentioned a single case which is also to be found in his book.

As it is no part of my purpose to make a complete catalogue of reputed prodigies, I shall not further enlarge my list. I have already given items extending over nearly twenty-five hundred years of history, which are sufficient to show that reports of miraculous operations in nature were so frequent and so nearly universal as to warrant our believing that they were, in general, founded in facts to which merely false interpretations were given. I do not mean to say that every single instance that has been recorded will fall under this generalization, for many may easily have been, and some probably were, pure inventions; and, as Livy says, "the more these were credited by simple and superstitious people, the more such stories multiplied." But each class of prodigies may be regarded as representing, or, rather, misrepresenting, a class of actually observed phenomena, and we may properly and profitably inquire what those phenomena were. Let us do this as briefly as possible.

1. The *Sweating and Weeping of Images, Altars, etc.*, may be disposed of without much delay, for it is almost impossible to conceive of any cause for this appearance except the commonly observed phenomenon of the condensation of watery moisture upon any relatively cold surface.

2. The *Bleeding of Statues, Shields, etc.*, may, I think, be explained, in some cases, by the sudden appearance of mere

rust ; though it is difficult to believe that at any historical time the process of oxidation was not well known even to the most unlearned. Still, we can imagine circumstances under which so simple and ordinary an occurrence might have been magnified into a sanguinary portent. The more reasonable explanation in most instances, however, would be the growth upon the object of a red lichen or alga, as, for example, *Hæmatococcus sanguineus*, or *Palmella cruenta*. The latter is known also, in popular language, as Gory Dew, which, as Dr. Carpenter says ("The Microscope and its Revelations," Sixth Edition, p. 292), "is common on damp walls and in shady places, sometimes extending itself over a considerable area as a tough gelatinous mass, of the color and general appearance of coagulated blood."

3. *Showers of Earth, Chalk, Ashes, etc.*, need no accounting for, in most cases, except upon the theory that, when not simply fictitious, they were probably what they were called ; for the drifting of sands from distant deserts or plains and the wafting of ashes from far-off volcanoes have always been common and well-understood occurrences. So-called rains of brimstone, however, may have been composed of pollen-grains or spores, or other vegetable products, resembling sulphur in color. Such a fall of pine pollen, which happened in Yokohama, Japan, in April, 1871, is described in "Science Gossip" for 1871, page 189.

4. *Showers of Oil* were probably never showers at all. The reports concerning them may have been occasioned by the discovery upon the earth or upon stones or plants, of greasy spots such as are produced by certain insects and some worms, or they may have arisen from the appearance upon pools of water left by rain of those iridescent films which, we now know, are caused by a variety of substances, including diatoms, iron-bearing earths, and, of course, fat or oil itself. Another cause of this appearance might be one of the gelatinous protophytes,—a *Nostoc*, for example, or a member of the order Palmellaceæ. Describing the beaded filaments of which the Nostochaceæ consist, Dr. Carpenter says (p. 297): "The masses of jelly in which they are imbedded are sometimes globular or nearly so, and sometimes extend in more or less regular branches; they frequently attain a very considerable size; and as they occasionally present themselves quite suddenly (especially in the latter part

of autumn, on damp garden-walks), they have received the name of 'fallen stars.' They are not always so suddenly produced, however, as they appear to be; for they shrink up into mere films in dry weather, and expand again with the first shower." And of *Palmoglœa macrococca*, which usually spreads itself as a green slime on damp stones, walls, etc., he remarks (p. 277): "It is curious to observe that during this conjugating process a production of oil-particles takes place in the cells; these at first are small and distant, but gradually become larger, and approximate more closely to each other, and at last coalesce so as to form oil-drops of various sizes, the green granular matter disappearing; and the color of the conjugated body changes, with the advance of this process, from green to a light yellowish-brown."

5. *The flowing of Oil* in brooks, fountains, etc., is probably the popular way of describing, under other conditions, the same iridescence to which I have already referred, and which needs no further consideration here.

6. *Showers of Wool, etc.*, are well elucidated by an account quoted in White's "Natural History of Selborne" (Letter XCVII.), of a sudden overspreading of the branches of a grape-vine "with large lumps of a white fibrous substance resembling spiders' webs, or rather raw cotton. It was of a very clammy quality, sticking fast to everything that touched it, and capable of being spun into long threads. * * * It remained all the summer, still increasing, and loaded the woody and bearing branches to a vast degree." It turned out to be a product of the *Coccus*.

7. *Showers of Milk*, like other reported showers, were probably merely so-called. The appearance of milk-white spots upon foliage might easily give rise to the belief that drops had fallen from the sky, when, in fact, no actual descent had been observed. Such milk-like spots may have been produced by many causes, but the cause which most readily suggests itself to a microscopist is some form of the fungus called "white rust," which frequently appears upon the leaves of cabbage, cauliflower, shepherd's-purse, etc., as patches resembling splashes of white-wash or spatters of milk.

8. The *Flowing of Milk* from the earth, in streams, etc., might be in most cases the superstitious interpretation of so sim-

ple a fact as the mixture of calcareous earth with ordinary running water, particularly after severe storms, at which times the ignorant mind would be in a state of easy impressibility and credulity. I suppose, too, that under favorable conditions some of the lower forms of both vegetable and animal life might multiply so enormously as to give a milky hue to considerable bodies of water, as they do constantly under our own observation in a smaller way.

9. *The Spotting of Bread, Grain, Leaves, Stones, etc., with Blood*, is a phenomenon easily accounted for by a very slight knowledge of the various forms and habits of the red and orange-yellow fungi. The bloody mould of bread has always been comparatively common, but the exact character of the organism producing it has never yet been clearly determined. Ehrenberg describes it as an animalcule, under the name of *Monas prodigiosa*. It has since been transferred to the algæ, with the title of *Palmella prodigiosa* : but there is still some doubt as to whether it should not be considered more properly a fungus. At any rate, it is to be found described in all the text-books. The gory staining of grain is attributable to what is known as "red rust," or "corn-rust" (*Trichobasis*), which in certain seasons is very plentiful on all kinds of grasses. The Rev. M. J. Berkeley speaks of a wheat-field in which not a single leaf was free from this fungus, "insomuch that a person walking through the wheat was completely painted with the spores, of a fine rust-red ;" and of course the spores would readily color the hands of laborers gathering the grain. The spotting of leaves of shrubs and trees is an occurrence within the experience of probably everyone of us, and simply to mention *Æcidium*, *Puccinia*, and *Uredo* is to suggest the explanation of numerous old-time marvels.

10. *The Flowing of Blood* in the ocean, rivers, springs, etc., is to be accounted for in some instances by the presence, in unusual quantities, of red algæ seen through the distorted eyesight of awe-stricken ignoramuses or pictured through the perverted imaginations of prejudiced *literati*. Thus the Sargasso Sea became to the ancient mind a stream of blood and the abode of death. It is said that certain infusoria occasionally become so abundant in the ocean as to give it a livid hue, and a rather fanciful origin has thus been invented for the

name of the Red Sea, though a much more reasonable one is found in the theory just mentioned with reference to the prevalence of red sea-weed. As to the appearance of blood in bodies of fresh water, we need to seek no further for a basis of fact than the well-known and well-understood circumstances connected with the characters and life-histories of some of the protophytes ; for example, the common *Protococcus pluvialis*, which, though usually green, is sometimes red, and which multiplies at times with most amazing rapidity. With regard to this remarkable organism I cannot do better than to quote Dr. Carpenter again, who says of it (p. 281) : "Rapid evaporation of the water in which the 'motile' forms may be contained, kills them at once ; but a more gradual loss, such as takes place in deep glasses, causes them merely to pass into the 'still' form ; and in this condition—especially when they have assumed a red hue—they may be completely dried up, and may remain in a state of dormant vitality for many years. It is in this state that they are wafted about in atmospheric currents, and that, being brought down by rain into pools, cisterns, etc., they may present themselves where none had been previously known to exist ; and there, under favorable circumstances, they may undergo a very rapid multiplication, and may maintain themselves until the water is dried up, or some other change occurs which is incompatible with the continuance of their vital activity. They then very commonly become red throughout, the red coloring substance extending itself from the centre towards the circumference, and assuming an appearance like that of oil-drops ; and these red cells, acquiring thick cell-walls and a mucous envelope, float in flocculent aggregations on the surface of the water."

11. *Showers of Blood* are in great part accounted for in what has just been said ; but there is one class of these sanguinary prodigies which is referable to a very curious phenomenon that takes place in the insect-world. You will find an account of several such wonderful occurrences in "Science Gossip" for 1871, page 45. One of the cases there mentioned happened in July, 1608, when "a supposed shower of blood fell for several miles around the suburbs of Aix-la-Chapelle. The cause of this was discovered by M. de Peiresc to depend upon the exudation of large drops of a blood-colored

liquid on the transformation of large chrysalides into the butterfly state. The drops produced red stains on the walls of the small villages in the neighborhood, on stones in the highways, and in the fields. The number of butterflies flying about, too, was prodigious." The writer of this account says: "On one occasion twenty-eight chrysalides of *Vanessa Antiopa*, or Camberwell Beauty, which I had preserved in a small room, attached to projecting bodies, underwent transformation on a single day in July. The walls and floor were so bespattered with bright crimson-colored fluid, resembling blood, as to give the appearance of a regular shower of the fluid." Figuier, in his "Insect World," describes the same phenomenon at some length, and quotes (p. 188) Réaumur as saying of the large Tortoise-shell butterfly: "Thousands change into pupæ towards the end of May or the beginning of June. Before their transformation they leave the trees, often fastening themselves to walls; and, making their way into country houses, they suspend themselves to the frames of doors, etc. If the butterflies which come out of them towards the end of June or the beginning of July were all to fly together, there would be enough of them to form little clouds or swarms, and consequently there would be enough to cover the stones in certain localities with spots of a blood-red color, and to make those who only seek to terrify themselves and to see prodigies in everything, believe that during the night it had rained blood."

12. "*The Red Snow*," says Dr. Carpenter, "which sometimes colors extensive tracts in Arctic or Alpine regions, penetrating even to the depth of several feet, and vegetating actively at a temperature which reduces most plants to a state of torpor, is generally considered to be a species of Protococcus; but as its cells are connected by a tolerably firm gelatinous investment, it would rather seem to be a Palmella."

13. *Showers of Flesh* are well exemplified by the so-called "meat-shower" which occurred in Kentucky in 1875, as most of us well remember. At the time, it caused almost as much ignorant wonder and gave rise to nearly as many nonsensical notions as it would have done hundreds of years ago. The first attempts at accounting for the marvel attributed it to a mysterious fall of *Nostoc*, but careful microscopical examina-

tions by Dr. A. Mead Edwards, Dr. J. W. S. Arnold, and others, subsequently demonstrated that the substance which fell was lung-tissue, cartilage, and muscular fibre ; so that the shower was of veritable meat. Still later it was made out that the tissue was that of a horse, and when finally the miraculous rain came to be connected with the appearance of a flock of buzzards, the whole secret was out ; for it is a habit of those unsavory birds to gorge themselves with carrion to the point of bursting and then to vomit, as they fly, what they are unable to retain.

Thus easily was a modern prodigy disposed of ; and quite as rationally, we now see, might we dispose of all ancient prodigies which were not mendacious fabrications, if only we could catechise witnesses and apply scientific methods to the examination of such facts as were found to remain.

APPENDIX.

It may be of interest to the curious to know how some of these prodigious events were explained by the pseudo-science of the seventeenth century, and so I append some extracts from a work entitled "*Speculum Mundi, or a Glasse Representing the Face of the World;* shewing both that it did begin, and must also end ; the manner how, and time when, being largely examined. Whereunto is joyned an Hexameron, or a serious discourse of the causes, continuance, and qualities of things in Nature ; occasioned as matter pertinent to the work done in the six dayes of the World's creation." "By John Swan, Mr of Arts, late Student of Trinitie Colledge, Camb.—A.D. 1643."

"And now it followeth that I divide all sorts of rain into two kinds : First, such as are ordinary ; secondly, such as be extraordinary.

"I call those ordinary when nothing but water falleth. And I call those extraordinary which others call prodigious rains : as when worms, frogs, fish, wheat, milk, flesh, bloud, wool, stones, iron, earth, &c., fall from the clouds. Plinie makes mention of many such prodigies as these, in the 56 chapter of his second book ; setting down the times when they happened.

"Concerning all which, next under God (the causer of the causes causing them) these or the like reasons may be urged to shew how it is possible they should be procured, and upon what causes they naturally depend.

"1. And first for the raining of worms; it may be thought that the putrefaction of some dead carcasses or other hath been drawn up into the aire as fumes and vapours are, where it breedeth such worms as use to breed out of the like matter here below.

"2. The like may be said of frogs, when the vapour is exhaled out of marish grounds at such times as they engender.

"3. So also of fishes; excepting that (as is supposed) the force of winds may suddenly sweep away little frey out of ponds upon montanous places; and so also little young frogs, with many the like things, may be taken up. Some write of a whole calf falling from the clouds; and have been thereupon perswaded that it is possible, of Vapours and Exhalations, with the power of heavenly bodies concurring, a calf may be made in the aire. But this is idle. It was therefore (as others write) taken up in some storm of whirlwind, and so let fall again.

"4. As for wheat and other grain, it hath been observed that their raining down hath often come in case of extremitie, to the great preservation and refreshment of the distressed: in which regard it may be supposed that it was an immediate work of God, wrought without the rule of nature: so that were all the wits in the world prest into one, yet were they all too weak to shew a true cause of such a prodigie. * * * To speak therefore as I think, I will not boldly affirm how this was caused, but onely touch at the possibilitie of it; namely, that it might be effected like unto other strange rains, first drawn from the earth into the aire, and then sent down again. * * * He that hath seen (saith one) an egg-shell full of dew drawn up by the sunne into the aire, in a May morning, will not think it incredible that wheat and other grain should be drawn up in much hotter countreys then ours is, much rather the meal or flower which is lighter.

"5. By the like reason also it sometimes raineth milk: for when the *intensissimus solis calor*, the vehement heat of the sunne, shall either draw milk from the udders of cattell, and shall mix it with the other parts of the cloud; or shall so throughly trie, purifie, digest or concoct the vapour, that it may look something white, then will the drops look as if it rained milk.

"6. As for the raining of flesh, it is supposed to be after this manner, namely through the drawing up of bloud from places where much bloud hath been shed, which being clottered together seemeth as if it were flesh.

"7. And so also it may rain bloud; namely when it is not clottered together, but thinner, &c. * * * But, say some, there is often great store of bloud spilt and yet no prodigie appeareth. To which is answered, that it is not the ordinarie exhaling virtue which resteth in the starres and Planets that can draw up such bloudy vapours, although much bloud be spilt; but then onely when there is a more unusual concurrence of causes: for sometimes they are disposed to one thing, sometimes to another. And for the working of any strange thing, it must be when there is a strange kind of combination amongst them. * * * And unto this also adde, that there may be drops like unto bloud, and yet no bloud drawn up; and this may be, either when the sunne draweth vapours out of putrified watery places, in which (as I have often seen) in a drought resteth much slimie and red-coloured corrupted water; or else when the Sunnes immensive heat doth so boyl the water in the cloud, that * * * it looketh red when it falleth.—The like cause I gave before unto the water of a white colour; but know that it must then be of another qualitie, the matter of the vapour I mean; for there are some kinds of waters, as is well known, which being boyled turn to white salt, &c.—And as for a red colour, the ordinarie rain sheweth that it is possible; for we see that ordinary rain-water looketh alwayes more brown then spring or river-water, being as if a more powerfull operation would turn it into red.

"8. The raining of wooll, or hair, is when a certain mossinesse like wooll, such as is upon quinces, willows, and other young fruits and trees, is drawn up by the Sunne among Vapours and Exhalations, which being clottered together falleth down like locks of wooll, or hair.

"9. Concerning stones, they proceed from earthly matter gathered into the clouds, as before was shewed concerning the Thunder-stone, &c. * * *

"10. Iron may also drop out of the clouds, when the generall matter of all metalls, which is quicksilver and brimstone, with the speciall matter of mixtion making iron, are all drawn up together and there concocted into metall. * * *

"11. And as for earth, chalk, dirt, and the like, it is drawn up in thin dust at the first with the vapour: Or else, by force of some wind blowing from caverns, or holes of the ground, it is carried up; and being conglomerated, or as it were glued together, falleth down again.

"12. But beside all these, there have sometimes been red drops, which falling upon men's garments have made a stain like unto a crosse. Such drops as these fell upon the clothes of the Jews, when in the dayes of the Apostate Julian they went about to restore their citie and temple. * * * But this surely was a thing altogether miraculous. For their red crosses came not alone, but were accompanied with other prodigies: * * * This was both the prodigie, and the issue of it: of which, being so plainly miraculous, I know not what to say.

"But I find that other times have in a manner afforded the like. Wherefore (although I speak nothing atall of these at this time thus miraculous) concerning them some reasons may be given.

"And not to go farre, Magirus, in the Comment upon his Physicks, telleth us that in Suevia, a Province in Germanie, in the yeare of our Lord 1534, the aire distilled certain red drops, which falling upon linen garments, made such an impression or stain as was like unto a crosse.[5] Which impression (as he alledgeth out of Cardan his sixteenth book *De subtilitate*) might be procured thus; viz., because a certain kind of extraordinarie dry dust sticked to those garments; which, by the piercing or through-washing drops falling upon it, was so miraculously divided into parts, that there seemed a figure as of a cross. Or thus, because the woven threads in themselves had such a form. Or else, (which is most probable) because the humour in the middle part lay on high, whereas the sides were but thin and fashioned according to the dashing of the drop. For when a drop falleth upon anything with a kind of force, we see that most of the humour resteth in the midst, whilest certain sparkling raies are dashed about the sides. And thus he thinketh it might be then, in the fall of those staining drops; which why they stain, hath relation to that which I said before concerning the raining of bloud.

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[5] Wolffhart, in his Chronicle, mentions instances of little *crosses* appearing upon clothing, etc., as follows:—

In the time of Julian the Apostate, about A.D. 367 or 8;—spoken of as rain or dew.

In the fifth year of the Emperor Constantine, A.D. 746;—referred to as being like oil.

A.D. 784, and A.D. 969, without any particulars.

A.D. 1503, in Germany, when they are said to have appeared on bread.

"I will therefore now conclude; adding in the last place, that the devil, by God's permission, both often hath and also doth produce many such prodigies as these that I have spoken of, with sundry other like unto them, especially amongst the Heathen, Pagan, and superstitious nations."

PROCEEDINGS.

MEETING OF JUNE 5TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Twenty-eight persons present.

Mr. R. I. Fearon was elected an Active Member of the Society.

OBJECTS EXHIBITED.

1. Photographs of Diatoms, taken by Dr. Henri Van Heurck: by THE SOCIETY.
2. *Cylindrospermum:* by A. D. BALEN.
3. Annular and spiral deposit from root of *Opuntia vulgaris:* by WALTER H. MEAD.
4. Section of human scalp; prepared by Mr. Arthur C. Cole, London: by EDWARD G. DAY.
5. *Vaucheria*, showing oögonia and antheridia; prepared by Mr. Arthur C. Cole: by J. L. WALL.
6. Transverse section of stem of Fleur de Lis: by B. BRAMAN.
7. *Mesocarpus* in conjugation; prepared by Mr. Arthur C. Cole: by B. BRAMAN.
8. Chapman's Mould for making microscopical cells: by E. B. GROVE.

DR. VAN HEURCK'S PHOTOGRAPHS OF DIATOMS.

President Van Brunt: "I have the pleasure of announcing that Dr. Henri Van Heurck has presented to this Society a copy of his 'Synopsis des Diatomées de Belgique,' together with a series of photographs taken by him with the incandescent electric light. Both the Synopsis and the photographs are here."

By vote of the Society, under motion made by Mr. C. S. Shultz and seconded by Mr. C. F. Cox, the Corresponding Secretary was instructed to convey to Dr. Van Heurck the Society's high sense of his generosity and of the great value of his gift. "Such an expression," said Mr. Cox, "is eminently fitting. Dr. Van Heurck holds a leading position among European investigators, and he has studied the Diatomaceæ with special care and distinguished success; and it is interesting to note that the results of his studies confirm the results of researches made in the same field in our own country. If we examine these photographs of Dr. Van Heurck, we shall find that they have a larger intention than to show the particular appearance of any one diatom; they bear upon the general question of the structure of the diatom shell."

CHAPMAN'S MOULD FOR MICROSCOPICAL CELLS.

The Chapman Mould, which was exhibited by Mr. E. B. Grove, is a convenient implement for making cells out of such plastic material as shel-lac, sealing-wax, or paraffine. It consists of a cylindrical core, and a removable collar concentric with it—both of brass. A rounded or bevelled shoulder inside the collar shapes the top of the cell, and a small shoulder on the core moulds a countersink suitable for the reception of the cover-glass. As a single mould is intended for but one size and one depth of cell, several are necessary to an outfit.

HARD-RUBBER CELLS.

Mr. C. F. Cox: "Excellent cells for mounting opaque objects may be made from hard-rubber tubes. A few years ago I ordered of a manufacturing company of this city a number of such tubes of the length of about one foot and of the exact sizes necessary, when made into rings, to take one-half-inch, five-eighths-inch, and three-fourths-inch cover-glasses. By means of a turning-lathe the tubes may be easily and evenly cut into cells of any desired depth. My tubing cost only a few dollars, but I have from it a supply of cells sufficient, probably, to last my lifetime."

ADDRESS ON CERTAIN SO-CALLED PRODIGIES.

Mr. C. F. Cox addressed the Society on the subject of the prodigies, so-called, of ancient and mediæval times, and showed the indebtedness of science to the microscope for an explanation of many of them. The Address is published in full in this Number of the JOURNAL.

Mr. J. D. Hyatt said: "In a place where I once passed the summer a phenomenon occurred which created much excitement. The surface of a considerable body of water that had collected in a low piece of ground near a cemetery, suddenly became covered with *Euglena sanguinea*, which gave the water the exact appearance of a pool of fresh blood. Some of the people were greatly alarmed, and they inquired of me the cause of the phenomenon. I explained it to them as clearly as I could; yet they still believe and would testify that this pool, situated so near the cemetery, was for many days that summer reddened with blood."

Meeting of June 19th, 1885.

The President, Mr. C. Van Brunt, in the chair.

Forty-five persons present.

Ivin Sickels, M. D., was elected an Active Member of the Society.

On motion of Mr. Mead it was voted that, when the Society adjourns, it shall adjourn to meet on the first Friday of October next.

It is the Society's custom to give to its last meeting prior to adjournment for the summer a partly social character. To this end it makes at this meeting a larger and more miscellaneous exhibition of objects than at its other regular meetings.

OBJECTS EXHIBITED.

1. *Lacinularia socialis*: by A. D. Balen.
2. *Closterium lunula*: by A. D. Balen.
3. *Peridinium spiniferum*: by C. S. Shultz.
4. Circulation of blood in foot of Frog: by J. L. Wall.
5. Cyclosis in *Vallisneria*: by Walter H. Mead.
6. Cyclosis in *Anacharis*: by James Warnock.
7. Cyclosis in *Nitella*: by James Warnock.
8. Micrococci from normal human saliva, showing chain-like arrangement of cells, and illustrating reproduction by fission in one direction: by Lucius Pitkin.
9. *Sarcina ventriculi*, showing cells in square clusters, and illustrating duplicative subdivision in directions at right angles to each other: by Lucius Pitkin.
10. *Cimex lectularius*, showing tracheæ and spiracles; bleached in hydrogen peroxide: by F. W. Leggett.
11. Spiracles in skin of *Dytiscus*: by Edward G. Day.

12. Arranged butterfly scales: by C. W. McAllister.

13. Foraminifera from Bermuda: by W. G. DeWitt.

14. Leaf of *Onosmodium Carolinianum*, showing curious pubescence: by J. D. Hyatt.

15. Palate of *Patella vulgata* (Limpet), showing teeth: by J. D. Hyatt.

16. *Syndendrium diadema*; mounted by Möller: by M. M. Le Brun.

17. *Papyrus*, transverse and longitudinal sections, from the Nile: by H. W. Calef.

18. *Echinus* spine, transverse section, by dark-ground illumination with Zentmayer's Abbe Condenser: by C. S. Shultz.

19. Sunstone—oligoclase spangled throughout with minute scales of gold-colored mica—from the Greeley farm, Chappaqua, N. Y.: by G. F. Kunz.

20. Artificial Sunstone, or Venetian Goldstone—glass spangled with brass filings: by G. F. Kunz.

21. "File" of Katydid: by B. Braman.

22. Spores of *Equisetum*: by B. Braman.

23. A Portable Cabinet, accommodating one hundred slides; designed by Prof. Hamilton L. Smith: by Edward G. Day.

NOTE ON PERIDINIUM AND ASTERIONELLA.

Mr. C. S. Shultz: "I have observed for several years that when the water-supply of New York or of other cities is pervaded with the gelatinous substance which gives it a fishy taste, neither *Peridinium* nor *Asterionella* abounds in it. The abundant occurrence of these forms accompanies and indicates a purer condition of the water."

HINTS ON MICROSCOPICAL MOUNTING.

At the President's request, Mr. E. G. Day gave some hints of his methods of microscopical mounting, as follows:—

"Wax cells may be readily made by using a pair of dividers about two and one-half inches long, furnished with a thumbscrew and having fine steel points. You may with this instrument cut from sheet wax a ring of any diameter, and by laying ring upon ring you can build a cell of any depth. The wall of such a cell may be punctured with a fine needle so as to allow the escape of moisture. The cell is best fastened to the slide with liquid marine glue, or with a solution of white shel-lac in methylated spirit, put on the slide with a brush.

"Much has been said against the use of white-zinc cement. When this preparation is of superior quality, like that furnished by Mr. Walmsley, and is properly treated, I find it an excellent material for shallow cells. Either white shel-lac dissolved in methylated spirit, or a certain preparation called ceramic glazing, will, if applied with a brush to the white-zinc ring, effectually protect the mounting medium.

"The formation of fungus-growths on the under-side of the cover-glass can always be prevented by the application of the smallest possible quantity of carbolic acid before the cell is closed.

"The best way, I think, of cleaning cover-glasses is to immerse them for five or six minutes in nitric acid and stir them about with a glass rod. The acid is then decanted, and the covers, after being thoroughly washed with water, are placed in alcohol in a wide-mouthed bottle, and are ready for use."

ADJOURNMENT TO OCTOBER SECOND.

The President: "The next meeting of the Society, which will take place October 2d, will have a somewhat social character, like the meeting of this evening. It is hoped that the members will bring to us at that time many interesting and valuable results of their summer observations and experiences."

VACATION.—With the publication of this, the July Number, the JOURNAL enters upon a three months' vacation. It takes this occasion to thank other scientific Journals for their expressions of good will, and it wishes them a summer of unusually agreeable work.

PUBLICATIONS RECEIVED.

National Druggist: Vol. VI., No. 22 (May 29th, 1885); pp. 15. No. 23 (June 5th); pp. 12. No. 24 (June 12th); pp. 14. No. 25 (June 19th); pp. 14. No. 26 (June 26th); pp. 11. Vol. VII., No. 1 (July 3d); pp. 14. No. 2 (July 10th); pp. 10. No. 3 (July 17th); pp. 10.

Brooklyn Entomological Society. Entomologica Americana: Vol. I., No. 3 (June, 1885); pp. 20. No. 4 (July); pp. 20.

The Electrician and Electrical Engineer: Vol. IV., No. 42 (June, 1885); pp. 40. No. 43 (July); pp. 40.

Comptes-Rendus des Séances de la Société Royale de Botanique de Belgique: May 3d, 1885; pp. 8.

Journal of Mycology: Vol. I., No. 6 (June, 1885); pp. 12. No. 7 (July); pp. 12.

The Botanical Gazette: Vol. X., No. 6 (June, 1885); pp. 16. No. 7 (July); pp. 15.

Description of *Carcharodon carcharis*; pp. 8. By W. G. Stevenson, M.D.

The Canadian Science Monthly: Vol. III., No. 1 (January, 1885); pp. 16. No. 2 (February); pp. 16. No. 3 (March); pp. 16. Nos. 4 and 5 (April and May); pp. 24.

Anthony's Photographic Bulletin: Vol. XVI., No. 11 (June 13th, 1885); pp. 32. No. 12 (June 27th); pp. 32. No. 13 (July 11th); pp. 32.

The American Monthly Microscopical Journal: Vol. V., No. 6 (June, 1885); pp. 20. No. 7 (July); pp. 20.

The Midland Naturalist: Vol. VIII., No. 90 (June, 1885); pp. 32.

The West-American Scientist: Vol. I., No. 7 (June, 1885); pp. 8.

The Microscopical Bulletin and Science News: Vol. II., No. 3 (June, 1885); pp. 8.

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The School of Mines Quarterly: Vol. VI., No. 4 (May, 1885); pp. 96.

North Staffordshire Naturalist's Field Club. Annual Report. 1884; pp. 140.

The Naturalist in Florida: Vol. I., No. 5 (May, 1885); pp. 6.

The Microscope: Vol. V., No. 6 (June, 1885); pp. 24. No. 7 (July, 1885); pp. 24.

Bulletin of the Torrey Botanical Club: Vol. XII., No. 5 (May, 1885); pp. 12.

The Journal of the Microscopical Society of Victoria: Vol. I., No. 1 (August, 1879); pp. 32. Nos. 2 and 3 (May, 1880); pp. 46. No. 4 (April, 1882); pp. 32. Vol. II., No. 1 (April, 1882); pp. 48.

Proceedings of the Newport Natural History Society, 1883–4; pp. 43. 1884–5; pp. 100.

Proceedings of the Natural Science Association of Staten Island: June 13th, 1885; 1 page.

Journal of the Royal Microscopical Society: Ser. II., Vol. V., Pt. 3. (June, 1885); pp. 196.

Proceedings of the Natural History Society of Glasgow: Vol. IV., Pt. 1. (1878–9); pp. 113+39+35. Pt. 2. (1879–80); pp. 4+331+7. Vol. V., Pt. 1. (1880–1); pp. 4+153. Pt. 3. (1882–3); pp. 71+7. Vol. I., New Ser., Pt. 1. (1883–4); pp. 71+7.

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JOURNAL
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NEW-YORK MICROSCOPICAL SOCIETY.

VOL. I. NOVEMBER, 1885. NO. 8.

PROCEEDINGS.

MEETING OF OCTOBER 2D, 1885.

The President, Mr. C. Van Brunt, in the chair.

Thirty-five persons present.

OBJECTS EXHIBITED.

1. *Volvox globator:* by A. D. BALEN.
2. *Hyalotheca:* by W. G. DE WITT.
3. Robber-Fly, showing tracheæ; bleached in hydrogen peroxide: by EDWARD G. DAY.
4. Arranged Diatoms—*Triceratium*, *Actinocyclus*, *Heliopelta*, etc.; by dark-ground illumination: by C. S. SHULTZ.
5. Diatoms from Lake Geneva—*Odontidium hiemale*, *Diatoma grande*, *Surirella Helvetica:* by E. A. SCHULTZE.
6. Diatoms—a fresh-water fossil deposit; by reflected light: by C. VAN BRUNT.
7. Seeds of *Orthocarpus purpurascens:* by G. S. WOOLMAN.
8. Silicified Wood from Arizona; transverse and radial sections: by M. M. LE BRUN.
9. Barbed Awns of Achenia of *Bidens frondosa*, *B. bipinnata*, and *B. chrysanthemoides:* by J. L. ZABRISKIE.
10. Rutile in Ceylonese Moonstone: by GEO. F. KUNZ.
11. So-Called Mummies' Eyes, from Peru: by GEO. F. KUNZ.
12. A Microphotograph: by F. W. DEVOE.

DIATOMS FROM LAKE GENEVA.

Mr. E. A. Schultze: "I collected my specimens of Lake Geneva diatoms at the base of the Castle of Chillon. Diatoms exist there in great abundance and purity, adhering to the rock. The upper part of the lake is rich in these forms, and the species occurring there are different from those inhabiting the waters of the lower part near the city of Geneva. Besides diatoms I found numerous desmids, among them the *Micrasterias denticulata;* also interesting infusorians, such as *Stephanoceros Eichhornii.*

"The intense blueness of the waters of this lake has attracted much scientific inquiry. Prof. Tyndall attributes it to the presence of mineral particles, probably glacier dust brought into the lake by rivers, and of so extreme minuteness as not to settle even when the water is allowed to stand a long time. Water taken from a depth of twenty-five or more feet I found to be almost cloudy when examined under the microscope, so heavily charged was it with this dust."

SILICIFIED WOOD FROM ARIZONA.

Mr. M. M. Le Brun: "My specimens of silicified wood exhibit the structure of the wood very perfectly in both transverse and radial section. The lenticular markings characteristic of the Coniferæ are preserved with special distinctness.

"I have brought two photographs of the locality which furnished this material. Of the many petrified tree-trunks shown in them, one is deserving of particular mention on account of its length and its situation. It is not less than one hundred and fifty feet long, and it spans a wide cañon which has been formed since the tree fell."

Mr. Geo. F. Kunz: "On account of the great beauty and variety of its coloring, this silicified, or agatized wood is beginning to be used in jewelry. It is worthy to take the place of Scotch agate and of blood-stone. With proper facilities for transportation fully one thousand tons of the material would become of commercial value for mosaic-work, table-tops, and other ornamental purposes."

BARBED AWNS OF ACHENIA OF BIDENS.

The Rev. J. L. Zabriskie: "Whoever brushes against a plant of the genus *Bidens* at its maturity has occasion to notice the facility with which the seeds detach themselves from it and cling to the clothing. Under the microscope each of the awns crowning these achenia is seen to be furnished with, commonly, three ranks of retrorse barbs which differ somewhat in character in the different species. The barbs on the four awns of *B. bipinnata*, or Spanish Needles, are remarkable for length and slenderness and for the acuteness of the angle which they make to the axis of the awn. The barbs on the several awns of *B. chrysanthemoides*, or the Larger Bur Marigold, are shorter, and their angles less acute, and on one or more of the awns they are ranged in two ranks instead of the usual three.

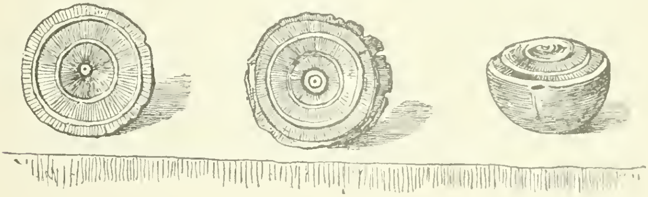
"It is an interesting fact that, while the barbs are very sharp, the tips of the awns themselves are blunt, being hooded by the bases of two or three barbs. They were obviously not intended for penetration. The character, position, and direction of the barbs fit the achenia for adhesion to the wool and fur of passing animals, and thus secure for the plant a wider dispersion."

RUTILE IN CEYLONESE MOONSTONE.

Mr. Geo. F. Kunz: "Rutile is a common inclusion in moonstone, and its presence usually lessens the value of the gem."

SO-CALLED MUMMIES' EYES.

Mr. Geo. F. Kunz: "My specimens of eyes taken from the mummies of Peru were loaned to me for this exhibition by the Messrs. Tiffany and Co. They are in fact the crystalline lenses of the eyes of *Loligo gigas*,—the Great Cuttle-fish of the Peruvian coast,—which, divided hemispherically, the embalmer substituted for the perishable and lustreless natural eye in order to give to the faces of the dead a more life-like appearance. These lenses possess a structure like that of the pearl, an aggregation of concentric layers. From lapse of time they have acquired a color varying from a light amber yellow to a rich amber brown. It is the opinion of some persons that a poisonous substance, such as arsenic, was used in the preparation of these lenses. This opinion, I am constrained to say, rests on inadequate grounds."



The diameters of the specimens exhibited by Mr. Kunz ranged between eight mm. and nineteen mm. The accompanying drawings represent three of the larger ones in their natural size.

Mr. H. B. Chamberlin, secretary of the Denver Microscopical Society, was present at this meeting. Responding to a request of the President, he described briefly and gracefully the membership, the meetings, and the work of his Society. The Society was organized two years ago, and it has now forty-five members.

MEETING OF OCTOBER 16TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Twenty-seven persons present.

Prof. Alfred M. Mayer, of the Stevens Institute of Technology, was elected an Active Member of the Society.

OBJECTS EXHIBITED.

1. Section of Carboniferous Limestone from Peoria, Ill., containing *Fusulina cylindrica* : by A. WOODWARD.
2. Head of House-Fly, transparent : by F. W. DEVOE.
3. *Pectinatella magnifica* : by A. D. BALEN.
4. Diatoms from Tampa Bay, Florida,—*Eupodiscus*, *Coscinodiscus*, *Triceratium*, *Auliscus*, *Actinoptychus*, *Navicula* ; collected by the Officers of the Coast-Survey : by E. A. SCHULTZE.
5. Cross-Fertilizing Apparatus of *Lobelia syphilitica*, L. : by J. L. ZABRISKIE.
6. Meteoric Iron from Glorièta Mountain, New Mexico : by GEO. F. KUNZ.
7. Seeds of *Alyssum maritimum* : by B. BRAMAN.

FUSULINA CYLINDRICA.

Mr. A. Woodward : "The foraminifer *Fusulina cylindrica* is found in abundance in the carboniferous limestone of Kansas, Nebraska, Missouri, and Illinois. For purposes of examination, the stone may be easily cut into thin sections, or perfect specimens of *Fusulina* may be picked out of it with little difficulty. This form assumes various shapes. Its surface between the septal furrows is generally smooth. The furrows themselves are rough, moderately distinct, and a little curved toward the extremities. The transverse section exhibited under the microscope shows the structure and number of the volutions, which are closely coiled, the spaces between rarely exceeding twice the thickness of the shell walls. In the adult the septa between the chambers number from thirty to forty in the outer turn of the shell."

PECTINATELLA MAGNIFICA.

Mr. A. D. Balen: "*Pectinatella magnifica* is an interesting object for the microscope when the colony is small. Often the colonies are too large to be placed in any receptacle that can be conveniently put under the instrument, having sometimes a diameter of seven or more inches; and they are not so easily kept alive as is a small one. To cut off a part is to peril the life of the whole. This species of Polyzoön is always found attached to some support. Its statoblasts are lenticular, and have anchor-shaped hooks radiating from their margin."

CROSS-FERTILIZING APPARATUS OF LOBELIA SYPHILITICA.

The Rev. J. L. Zabriskie: "The flower of *Lobelia* furnishes an interesting example of the possession of ingenious apparatus designed for securing cross-fertilization. In no one, perhaps, of the thirteen species found native in the northern part of the United States, is this contrivance exhibited more plainly than in the species *syphilitica*. The five filaments are separate, but the anthers are united into a capacious tube which is bent to one side and, at the maturity of the stamens, is filled with a mass of loose pollen-grains. The aperture of the tube is bearded on the lower side with white bristles. The stigma is fringed with stiff hairs which, radiating in all directions, occupy the whole diameter of the space inclosed by the anthers. At the first opening of the flower the stigma is found at the inner end of the anther-tube. Then the style, elongating by growth, urges the stigma upward, and pushes the pollen before it to the brush of bristles which, attached, as we have seen, to the lower side of the aperture, appears well adapted to transfer the pollen to the back of an insect passing into the flower.

"Another fact deserves notice. When an insect large enough to press against this apparatus and bend it upward enters the flower, the filaments, flexed by the pressure, retract the anther-tube, while the style, which remains rigid, causes the stigma to act in this case also like the plunger of a force-pump.

"Though the stigma, when the flower is young, is immersed in the pollen-mass, it is unable to appropriate that pollen. For its two lobes are pressed together like a pair of closed lips, giving the appearance of a serpent's head. But as the flower fades, the pistil increases in length, and finally the stigma projects through the aperture of the anther-tube, and then the lips open widely, exposing the stigmatic surface to be acted on by the pollen brought from another flower.

"The specimen exhibited is a longitudinal section through the anther-tube, showing the inclosed pollen-mass, the bearded aperture, and the stigma, with its collar of bristles, at the inner end of the tube. There is exhibited also the anther-tube of a mature flower, with the stigma protruding and widely opened.

"This subject was clearly explained and illustrated in "The American Naturalist" for 1879, by Prof. J. E. Todd, and also, in another article, by Prof. William Trelease."

WHITE ROSIN AS A MOUNTING MEDIUM.

Mr. William Wales: "Some time ago it occurred to me that white rosin might prove a good medium for mounting microscopic objects. It is easily soluble in alcohol, it melts readily, it cools quickly, and it is more transparent than balsam. I have found it a better material than balsam for cementing lenses, and I deem this a good test. At my desire, Mr. Henry L. Brevoort has given it a trial as a mounting medium. He has just communicated to me the result in writing."

Mr. Wales then read Mr. Brevoort's communication. Its main points are here given, in substance. 'The results of my experiments in mounting with white rosin are very satisfactory. My method is the following: On the centre of a clean glass slide laid on the heating table, I put a small piece of rosin of the purest quality. Heat is gently applied until the rosin becomes as liquid as it can be made without burning it. To remove air-bubbles, with a pointed glass rod I add to the liquefied rosin, and stir in with it, a half-drop of turpentine. A moment or two after the object to be mounted has been placed in the medium and the cover-glass has been dropped upon it, the slide must be removed from the hot table and a spring clip applied. In five minutes the mount will be ready for finishing and labelling. I have studied such objects as hairs and fur-fibres for three or four years, and I find rosin preferable to balsam as a medium for mounting them.'

ILLUMINATION BY AID OF AIR-BUBBLES.

'For very delicate structures, such as fur-fibres,' continues Mr. Brevoort, 'I often purposely permit air-bubbles in the mounting material, or introduce them into it. The chances are that some of the fibres will pass through some of the air-bubbles, and when they do this in the proper position, the fibres will be found to be illuminated by the reflection of light from the upper part of the concave surface of the bubble, and the surface of the fibres may be studied with a $\frac{1}{16}$th-inch immersion lens as readily as with a 1-inch. This method of illuminating I find of great service with the highest powers. I have used it with balsam and glycerine. With the latter it works exceedingly well. The air-bubbles may best be introduced by means of a stylographic pen-filler.'

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MISCELLANEA.

MICROSCOPE, MICROSCOPIC, MICROSCOPICAL.—The practice of even the most scholarly microscopists is not quite uniform in the employment of the words microscope (used adjectively), microscopic, and microscopical. Is it not desirable to make an effort to bring about uniformity? The usage which best commends itself to us is in accord with the following directions:—

1. Apply "microscope" (the adjective) to the component or essential parts of the microscope. *E. g.:* microscope stand, microscope stage, microscope objective.

2. Restrict "microscopic" to objects or features too minute to be seen or appreciated by the naked eye.

3. Reserve "microscopical" for uses to which the term "microscopic," as above restricted, would be inappropriate. *E. g.:* Microscopical Society; microscopical accessories; microscopical science, works, observations, researches, themes, purposes, uses; microscopical examination.

As an epithet to the word "examination," microscopical is certainly preferable to microscopic, since the idea intended to be conveyed is of an action performed with the aid of the microscope, rather than of one too minute to be visible to the naked eye.

Among professional men an organized society of microscopists is now generally, if not universally, denominated a Microscopical Society. "Microscopic Society" is sometimes heard, and, unfortunately, it sometimes gets into print. Its use ought to be actively discountenanced.

MECHANICAL SELF-DIVISION OF STENTOR.—A *Stentor* was recently observed by the writer to divide itself into two nearly equal parts by what appeared to be a mechanical process. By a vibrating gyratory movement[1] frequently repeated for two hours, the anterior part was, as it were, twisted off the posterior. The oral segment migrated to the border of the cage, and retained its vitality eight hours. The other segment developed a new oral spiral at its torn extremity, and became at the end of about ten hours a complete individual.

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[1] Like the motion of the balance-wheel of a watch.

CHALCEDONY PARK, the name given to the area of one thousand or more acres in which occur the jasperized or agatized trees of which mention was made in the meeting of October 2d, is situated a few miles from Corriza, a station on the Atlantic and Pacific Railroad. The trunks are partly buried in beds of lava and sandstone, and large wheel-like fragments lie scattered about. The substitution of silex for woody fibre must have been effected through the agency of siliceous waters.

Under a good microscope—a binocular is best—a piece of coniferous wood, illumined from above, will often be semitransparent to a depth of the aggregate thickness of three or four plates of cells. It thus, with its several ranks of lenticular markings, becomes a more beautiful object than when, in thin section, it is viewed by transmitted light. We have had opportunity to examine the silicified wood from Chalcedony Park only as an opaque object. Some of the specimens exhibited with great distinctness the structure just described, but of a beauty far more striking, owing to the crystalline character of the material and the exceeding richness of the coloring.

COCAINE HYDROCHLORATE FOR MOUNTING ANIMALCULA.—The action of the reagents in general use for killing animalcula for mounting disturbs the natural appearance and position of such delicate structures as the tentacles of Hydroids and Bryozoa. Prof. J. Richard has successfully employed in these cases the anæsthetic power of cocaine hydrochlorate. Several of the animalcules are placed in a watch-glass with five cubic centimetres of water. When they are fully expanded a ½ per cent. solution of cocaine hydrochlorate is added drop by drop until it forms a fifth part of the entire fluid. Half a cubic centimetre of the anæsthetic is then added, and the animals become completely fixed. Ten minutes afterward they are quite dead, and can be mounted in the ordinary way.—See *Jour. Roy. Mic. Soc.*, 1885, p. 893.

PROFESSIONAL MICROSCOPY.—So long as mind is associated with matter, uses its energies, or is obstructed by its limitations, will the knowledge of the laws of physical life interest man nearly, and aid him to his goal. Indeed, biological investigation is, if we mistake not, the most absorbing of present purely scientific pursuits. The nature of the force called life may continue an enigma ; its law of work, however, may yet become fully known, and this fulness of knowledge may better incalculably man's estate.

But biology owes its existence to the microscope, and to that instrument must it look for its progress and its triumphs. And what, in its present state, is this instrument, with its immediate accessories, and all its various kinds of subsidiary apparatus ? and what the scope and quality of intelligence, of knowledge, of training of eye and hand, embraced in its mastery ? To this question, the story, however simply told, of the work performed by Dr. Koch in his studies of bacterial life, or by Drs. Dallinger and Drysdale in their researches on the origin and life-histories of the " least and lowest of living things," would be a grand and sufficient reply.

There is, then, a science of microscopy. Its mastery is peculiarly difficult, requiring rare sagacity and dexterity, and a lifetime of devotion, and its study has become a profession. This fact is not known to all, it having grown too fast for any but a watchful eye to keep pace with it. " There is no science of microscopy—the microscope is only an instrument," was said in our hearing a few days ago. A gun is but an instrument ; yet is there not a science of gunnery ? and its acquisition is an indispensable part of the professional soldier's education. The importance of a special and systematic course of instruction in microscopy is gaining recognition in some of our best institutions of learning.

MICROMETRY AND BLOOD-CORPUSCLES.—No microscope is complete unless equipped with ample and accurate means of micrometric measurement, and no man who does not fully understand the use of those means is entitled to be called a professional microscopist. He who possesses this accomplishment has facilities for adding valuable material to the stock of human knowledge. The careful measurements made by Dr. Ewell, of Chicago, of the diameters of human blood-corpuscles may yet prove of inestimable service in some cases of medical and criminal jurisprudence. Where the issue of life and death is involved, Dr. Ewell declares it reckless, if not criminal, to express an opinion upon a measurement of fewer than one hundred corpuscles.

THE CLEVELAND CONVENTION.—The sessions of the American Society of Microscopists at its Eighth Annual Meeting were fruitful of instruction, stimulus, and delight. The Addresses, the Papers, the illustrations of work and of methods at the Working Session, and the Soirée, at which fully fifteen hundred persons viewed the fine selection of objects on exhibition under more than one hundred and fifty microscopes, must have made upon even the casual observer an ineffaceable impression of the precision with which scientific research is now conducted. The excellence of the Report of its Proceedings, great as it will be found to be, will be incompetent to work out in the mind of one not present at the Convention the more subtle and enduring education which would have sprung from attendance in person.

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PROCEEDINGS.

MEETING OF NOVEMBER 6TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Forty-three persons present.

Mr. Edmund B. Southwick and Mr. S. Lowell Elliott were elected Active Members of the Society.

OBJECTS EXHIBITED.

1. Diatom deposit ; mounted in silicate of soda : by F. W. LEGGETT.

2. Nummulitic Limestone from the Eocene at Gizeh, Egypt, containing *Nummulina complanata* and the variety *N. Gizensis* : by A. WOODWARD.

3. *Nitzschia*—fifty-two specimens, illustrating as many species; mounted by Möller : by E. A. SCHULTZE.

4. Crystals of Chalcotrichite (Red Oxide of Copper) included in transparent Calcite, from north shore of Lake Superior : by GEO. F. KUNZ.

5. Mounted preparations of a Phosphorescent Organism obtained from the surf at Ocean Beach, N. J.: by ALEXIS A. JULIEN.

SILICATE OF SODA AS A MOUNTING MEDIUM.

Mr. F. W. Leggett : " I have found silicate of soda a good mounting medium. It is transparent, and the mount is quickly made."

Mr. C. F. Cox : " Does the medium continue transparent ?"

Mr. Leggett : " Perfectly so, within my experience."

Mr. Cox : "I once made many trials of the silicates of soda and potash as a mounting material, but not with satisfactory results. I invariably found that, sooner or later, the soda or potash was deposited in crystals."

A PHOSPHORESCENT ORGANISM FROM THE SURF AT OCEAN BEACH, N. J.

[ABSTRACT.]

Dr. Alexis A. Julien: "Some remarkable displays of phosphorescence of the sea occurred along the coast of New Jersey this fall, especially on the 1st and 11th of October and the 1st of November. A strong wind from the ocean, with an elevation of the temperature of the water, always preceded these displays, and an abundance of several species of Acalephæ and Ctenophora was their invariable accompaniment. The sand along the shore at Ocean Beach became saturated with the phosphorescent agent, and it continued thus saturated even long after the almost entire disappearance of the phosphorescence from the sea, until, finally, in November, the whole mass was scooped out and washed away by the violent surf of a winter storm.

"The phosphorescence in the sand was not continuous. It manifested itself only when the sand was agitated or disturbed by the lapping of the waves or by the foot of a person walking.

"On one occasion I found in the water and on the beach a small species of Ctenophore, which, on being rubbed between the palms of my hands, made them phosphorescent.

"It was found possible to concentrate the phosphorescent agent in the sea-water by filtration through paper, notwithstanding the exceeding minuteness of the individual organisms, to be now described, which constituted it.

"The phosphorescent agent was found to be a bowl-shaped organism furnished with a flagellum-like appendix and having an elliptical contour with a 3.7μ major axis and a 1.6μ minor axis. Much difficulty was experienced in the study of the morphological characters of the organism, on account of the high magnifying power required. A $\frac{1}{16}$th-inch homogeneous-immersion and a $\frac{1}{12}$th-inch dry objective were the powers mainly employed. When the sea-water was placed in a vessel, the organism was found to swim freely, and to be easily kept for fully eleven days, though subject to changes of temperature of, at least, 20° F. It was excited to a brilliant display of its greenish-white light, and finally killed, by the action of reagents, such as osmic acid, alcohol, and even hot water. When a vessel of the luminous sea-water had been allowed to stand a few hours in warm weather, the bacteria and infusoria which attend decomposition made their appearance. As these increased, the phosphorescent organisms decreased until they all died, and sank to the bottom of the vessel.

"An exact identification and description is reserved until additional examinations have been made ; but the organism is believed to be one new to science, and quite distinct from *Noctiluca*, which was entirely absent from the phosphorescent sea and sand."

[DISCUSSION.]

Mr. J. D. Hyatt : "I have found Ctenophora in abundance in the East River. Even after one of these animals has been broken into pieces, the cilia, each with a cell attached, will keep up their motion a considerable length of time."

Dr. Julien : "The Ctenophora do not possess filamentous cilia, but broad, comb-like appendages, much larger than that of the new organism, and of entirely different shape. When they are torn into pieces, their fragments do, it is true, remain phosphorescent and vibratile, but I have found that their motion and phosphorescence cease in a few hours."

Mr. C. F. Cox : "Whatever the character or place of the organism which Dr. Julien has brought to our notice may prove to be, his observations have not, I think, established a causal relation of that organism to the phosphorescence of the ocean. Indeed, I doubt if there was any connection between the two. I think that the phosphorescence was occasioned by certain general conditions, which conditions were likewise favorable to the existence of the alleged new organism. The fact, given by Dr. Julien, of the invariable presence of a number of well-defined concomitants of the phosphorescent displays, lends support to this view.

"The behavior of an oxidizable substance in a state of unstable equilibrium is well known. Strong reasons for believing that phosphorescence is only oxidation, and that this oxidation takes place most readily in the presence of such salts as are contained in sea-water, were collated in the "Journal of the Royal Microscopical Society" for 1881, pp. 581, 582. It is the testimony of a recent traveller in Florida that some bars of iron submerged in sea-water were made brilliantly luminous for a whole night by a few minutes' contact with the body of a jelly-fish. The luminosity, in this instance, was doubtless owing to the disorganization of organic matter, and the phosphorescence spoken of by Dr. Julien as retained on the palm of his hand proceeded, probably, from the same cause.

"To demonstrate a necessary connection between a living organism and phosphorescence, the organism must be actually seen emitting phosphorescent light."

Dr. Julien : "I concede the desirableness of seeing this new organism flash out with phosphorescence under the microscope—and I hope yet to witness the phenomenon, notwithstanding the greatness of the difficulty imposed upon such observations by the use of the high-power objective demanded in this case.

"The old theory, I am well aware, attributes phosphorescence, in some instances, to the oxidation of decomposing organic matter ; but I accept, rather, the product of those recent investigations of many observers which have thus far shown that, though the causes of phosphorescence are various, they may in all cases be referred to some living organism—the phosphorescence of wood, for example, to the mycelium of a fungus, and, possibly, the phosphorescence of living Acalephæ to the oxidation of fatty globules in certain specialized glands or receptacles. In the Ctenophora, phosphorescence seems to be connected with nerve-force and muscular contraction, and to the same agency I incline to refer the phosphorescence in this new organism."

Dr. N. L. Britton : "The theory favored by Dr. Julien, that the kind of luminosity called phosphorescence is correlated with nerve-force, readily accounts for phosphorescence in living animals. Electrical currents, it is now believed, accompany nerve-force ; and electricity and light, being molecular energies, are interchangeable."

Dr. Julien : "Dr. Gould has repeatedly noticed that, when the Medusæ are collecting their food, the moment they touch their prey it seems to be paralyzed, not as if it had been mortally stung by the lasso-cells, but as if there were another force involved. Possibly phosphorescence is often the visible evidence of the presence of an electrical current."

MEETING OF NOVEMBER 20TH, 1885.

The President, Mr. C. Van Brunt, in the chair.

Twenty-two persons present.

Mr. William Beutenmüller was elected an Active Member of the Society.

The President appointed Mr. Braman, Mr. Zabriskie, and Mr. Wall a committee to present at a subsequent meeting a written expression of the sentiments of the Society in view of the death of Dr. William B. Carpenter.

OBJECTS EXHIBITED.

1. Feather Crystals of Uric Acid from a Caterpillar; shown by polarized light: by F. W. DEVOE.

2. *Selaginella inæquifolia*, longitudinal section of Fertile Spike, showing Sporangia and Spores; prepared by Mr. A. C. Cole: by J. L. WALL.

3. *Daphnia pulex*: by A. D. BALEN.

4. *Pithophora Kewensis*: by W. G. DEWITT.

5. Longitudinal radial section of the Wood of the Sugar Pine (*Pinus Lambertiana*, Dougl.): by J. L. ZABRISKIE.

6. Twenty-eight Sketches, showing Lenticular Markings of as many species of Coniferous Woods: by J. L. ZABRISKIE.

FEATHER CRYSTALS OF URIC ACID FROM A CATERPILLAR.

Mr. F. W. Devoe: "My slide of crystals of uric acid was prepared by Dr. Samuel Lockwood. To my inquiry respecting the method of its preparation, he has sent the following answer:—

"'Uric acid, with its compounds, the urates, as obtained from animals, shows, while observing certain laws, a great variety of forms. The feathery crystals, like those on this slide, excel in analytical power with the polarizer. It is not an easy matter to obtain these crystals from the juices of the caterpillar. I have tried it many times, and only three times have I succeeded. My method is very simple. Get your caterpillar, and have ready, say, six slides, absolutely clean. Puncture the caterpillar with point of penknife or of scissors: a drop of green liquid will exude. Put some of this liquid on each slide, spreading it out a little so that it shall not lie too thick. Place the slides in a temperature of about 70° F., or the ordinary heat of a comfortable room, and put over them a piece of paper to exclude light and dust. In about half an hour they should be dry, and, if you are successful, the crystals, few or many, should be formed. If you get the crystals, mount with balsam. If the crystals are *urea*, early mounting is advisable, since their easy solubility might put them in peril on account of the natural moisture in the air. If they prove to be *urates*, which are not so soluble, the mounting can, if necessary, be deferred.

'I think it a little curious that, many years ago, I obtained feather crystals identical with those on this slide, from the excreta of the Pine Snake.'"

LACINULARIA SOCIALIS.

Mr. A. D. Balen: "This beautiful rotifer gets its specific name from its habit of living, not only in colonies, but in an association of colonies. It attaches itself to the stems of plants. In a small handful of weeds I have sometimes found fifteen or twenty colonies, each of which contained from five to thirty individuals."

PITHOPHORA KEWENSIS.

Mr. W. G. DeWitt: "Dr. Cooke, in his 'British Fresh-Water Algæ,' pp. 146, 147, says that the Alga named *Pithophora Kewensis* was originally discovered in a tank in the Water-lily house of the Kew Gardens, and was thought by Wittrock to have been an importation from Brazil. The plant grows well in captivity. It has fruited and kept itself fresh during the two months in which it has been in my aquarium."

Mr. A. D. Balen: "This Alga was, for some time, supposed to be purely tropical. Mr. Francis Wolle, with the assistance of one or two friends, has shown that it is not uncommon in the temperate zone. I have found it in five localities near Plainfield (N. J.)."

THE LENTICULAR MARKINGS OF VARIOUS CONIFERÆ COMPARED.

The Rev. J. L. Zabriskie: "The interest excited by Mr. Le Brun's exhibition, on the evening of October 2d, of two beautiful specimens of jasperized wood from Chalcedony Park, Arizona, which showed so distinctly the lenticular markings belonging to the wood-cells of the Coniferæ, has led me to examine the comparative size of the markings in the coniferous woods, of various species, which I have prepared for microscopical purposes, and I find those in the famous Sugar Pine (*Pinus Lambertiana*, Dougl.) to be the largest.

"In all the conifers these markings are remarkably uniform in size in the same species, and they are the most abundant and conspicuous in the tracheïde cell-walls which lie next to the medullary rays, and hence they are best shown in a longitudinal radial section. Such is the section on exhibition. The magnification is 250 diameters.

"I exhibit also a series of sketches—drawn under the camera, and with the same magnification of 250 diameters—of the lenticular markings belonging to twenty-eight species of coniferous woods. I have endeavored, in each instance, to select for comparison a portion of a cell having the greatest number of markings which I could find at the time, so as to give each species the same advantage. By the side of the column of sketches, I have drawn, under the magnification given above, the divisions of a stage-micrometer showing $\frac{5}{1000}$ths of an inch. Thus each sketch presents, of each wood-cell, a portion $\frac{5}{1000}$ths of an inch in length.

"The largest markings—those of the Sugar Pine—are about $\frac{1}{1000}$th of an inch in diameter.

"Next in order follow the Georgia Pine (*Pinus palustris*, Miller), the California Redwood (*Sequoia sempervirens*, Endl.), the Giant Tree (*Sequoia gigantea*, Decaisne), and the Yellow Pine (*Pinus ponderosa*, Dougl.).

"The smallest markings here sketched are those of the Canoe Cedar (*Thuja gigantea*, Nutt.) of Oregon and Alaska. The markings are just one-half the size of those of the Sugar Pine, or $\frac{1}{2000}$th of an inch in diameter.

"It will generally be found, as might be expected, that the number of the markings in a certain length of cell bears an inverse ratio to their size. Where the markings are large, they are comparatively far apart; where they are small, they are numerous and crowded and may form two almost distinct rows.

"Between the size of the wood-cell and the size of the markings, there seems to be no correspondence. The cells of the Georgia Pine are the largest that I have seen in any cone-bearing tree, but the markings are not so large as in the Sugar Pine. The Canoe Cedar has larger cells than the Western Cedar, but the latter has the larger markings."

Mr. M. M. Le Brun: "In such of my specimens of the Arizona fossil wood as show its structure distinctly, I have examined the lenticular characters with reference to a comparison with those in *Sequoia gigantea*, and have found them smaller, and closer together. I noticed also that they are ranged sometimes in a single row, sometimes in two alternating ones."

IDENTIFICATION OF THE ARIZONA FOSSIL WOOD.

In answer to an inquiry of the President if the Arizona fossil wood had been all identified,

Mr. P. H. Dudley said: "This silicified wood is of many and greatly differing species, a few of which, belonging to the genus *Araucaria*, have been identified through the shape of the contour assumed by some of the lenticular markings. When a longitudinal radial section is examined, near each end of many of the vertical wood-cells the markings will be seen lying in two rows, those of one row alternating with those of the other, as Mr. Le Brun has said. But, further, these markings have no interspaces, being so crowded that the normal circular outline of each is converted, except along its free outer portion, into a hexagonal figure—the distinctive microscopic feature of the living genus *Araucaria*. I ought to add, as the result of a long and careful study of the specimens in my possession, that such of the cells as have from end to end but a single row of markings are confined to the outer portion of each of the annual rings.

"In many of my specimens of this wood, spaces are seen which exhibit no cell-structure, the woody fibre having been broken down prior to the siliceous infiltration. In some of these I have detected the mycelium of the fungus which had caused the decay."

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MISCELLANEA.

THE BEST LENSES ONLY.—The student in biology or histology who has once seen and appreciated the performance of a superior lens, will never afterward be content with an inferior one. To trust and use the latter in pioneer work, is to act unwisely, and to fall hopelessly behind in the race.

SEEDS OF ORTHOCARPUS PURPURASCENS.—The fully-ripe seed of the *Orthocarpus purpurascens* has become a favorite object for exhibition under the microscope. Its chief interest centres in the white net-like sac in which the kernel is incased. This sac is the *testa*, or outer coat of the seed, and consists of a single layer of two hundred or more cells which, through complete contact with and adhesion to one another, have acquired firm, hexagonal walls, while the inner and the outer walls have, through absorption, become nearly or quite obsolete. An open favose or honey-comb aspect is the result. The sac is oblong-ovoid, and has an average length of about 1.35 mm. The free, movable, amber-brown kernel is about .75 mm. long.

This plant belongs to the Scrophulariaceæ, and closely resembles *Castilleia*, or the Painted-Cup. In some places on the California coast it grows so abundantly that the crimson summit of its corolla and the crimson-purple tips of the calyx-lobes and floral bracts give their hue to the landscape.

COMPLETION OF VOL. I.—The First Volume of the Journal of the New-York Microscopical Society concludes with this Number. No effort has been spared in the conduct of this periodical to gain for it the confidence of its readers. The Editor would have been glad to enlarge its scope, so that it should embrace, besides the Transactions and Proceedings of the Society, short studies in the science of the microscope and in various departments of microscopical work. But the pressure of other claims upon his time has obliged him to deny himself the gratification of this desire. The same pressure now makes it his duty to ask the Society to relieve him altogether of the charge of the JOURNAL and put it into other hands. Whatever regret he may feel in giving up this care is lessened by the reflection that the pleasure which he will lose passes to another's gain.

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